Integrated Environmental Solutions Limited

VE-Gaia

ASHRAE 90.1 App-G PRM Navigator

Version 6.4.05

<Virtual Environment> design, simulate + innovate

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1. VE-Gaia: PRM Navigator Introduction

VE-Gaia = Step-by -step analysis workflows - - VE-Gaia's complete workflow environment is driven by "step-by-step" smart navigation that opens wide the power of IES analysis. A series of Navigators guide users through a range of tasks; from advanced modelling, to energy/carbon analysis, to LEED and Green Star credit interrogation and report creation

2. VE-Gaia: PRM Navigator – What makes it different?

The PRM Navigator establishes a 'workflow concept' to guide the user through the Performance Rating Method process. It particularly targets the USGBC LEED Energy & Atmosphere Credit 1 – Optimize Energy Performance energy modeling process, however it can be used in a number of other ways as well. For example, the following Green Rating Systems (but not limited to) that are used in different parts of the world also point to ASHRAE 90.1 Appendix G – PRM process as the requirement for energy credits as well:

- LEED Canada (points to ASHRAE 90.1-2007)
- Estidama (points to ASHRAE 90.1-2007)
- LEED India (points to ASHRAE 90.1-2004*)

**template data within the PRM navigator is based on 90.1-2007 version, so user will currently need to edit the input assumptions to run analysis for a different version of ASHRAE 90.1.*

What makes it different from other tools that are used for energy modeling?

- **It could be generally categorized as a wizard, but it's a 'smart navigator':** The PRM Navigator not only allows users to implement and manage the PRM process in a new way it also 'navigates' how the user can access the different VE-Pro modules required (see required module list below) to complete the different types of analysis involved in the PRM process in a streamlined manner. The user is also given real-time feedback along the way so they can compare how their design stacks up to the 90.1 requirements.
- **5 in 1:** All five models (proposed design + 4 baseline models) required for the PRM live in one file versus having to maintain the data across five different model files.
- **Input Data Once and Manage Edits effectively:** The manner in which inputs are handled allows the user to input the data within the model, which influences the inputs in all five models.
- **Creating the Baseline Models:** The required baseline models are generated from the proposed design filtered through the requirements of ASHRAE 90.1 Appendix G, at the stage in the process the user chooses to develop them. The user has two choices…

3. VE-Gaia: ASHRAE 90.1 App-G PRM Navigator Structure

The main objectives of the VE-Gaia PRM (Performance Rating Method) Navigator are to:

1. Manage the overall process, including inputs, edits and cycles of the PRM (ASHRAE 90.1 Appendix G)
2. Provide industry recognized defaults and input selection options (ASHRAE standards data as the basis) to assist the process

A range of individual software modules and features are available within the VE-Pro suite which can be used to construct a detailed PRM model. The user needs to manually switch between modules and know at which point in the process a specific feature needs to be used. In summary it can be difficult to understand how each module and feature fits into the overall PRM workflow analysis process.

The VE-Gaia PRM Navigator is a tool which brings all of the individual VE-Pro modules and features together in a single area and presents the user with step-by-step smart navigation and management of the PRM workflow and analysis process. The Navigator is driven through the successful execution of specific actions and commands which are activated by the user in a defined sequence.

This smart navigation leads the user through the process of basic geometry creation, to constructions/thermal data assignment, and ultimately to the automatic generation of a full set of PRM compliant results which are presented in a format similar to the LEED EAc1 Letter Template.

The Navigator also provides the user with predefined prototypical ASHRAE data which can be used to populate the model with default baseline information.

The main structure of the PRM Navigator workflow includes:

1. Preliminary Data setup
2. Envelope Thermo/Physical Properties
3. Room/Zone Thermal Template Data
4. HVAC systems
5. Other Input Data
6. Generate Baseline
7. Sizing runs
8. Simulations
9. Results

The ASHRAE 90.1 App – G PRM Navigator functions as a series of hyperlinks that are accessed within the smart navigator tree structure that is located on the upper left side of the interface. The hyperlinks take the user to the relevant VE-Pro module and dialog box to complete the tasks associated with that topic.

> *Note: that the user can increase the size of this area by dragging downward on the border between the VE-Gaia workflows area and the Rooms area.*

4. VE-Pro Modules to utilize with PRM Navigator

The following list of VE-Pro modules are classified into two categories – required and beneficial. It is recommended that the user confirm which VE-Pro modules they have licenses for, so that they have the full capability of the PRM navigator available.

- Required:
  - ModelIT
  - Suncast

  - ApacheSim
  - ApacheLoads
  - ApacheHVAC
- Beneficial Based on what type of efficiency measures or HVAC system is being analyzed:
  - FlucsPro, LightPro, Radiance
  - Macroflo

Figure 1 provides an over of the Virtual Environment software platform. The upper right portion of the diagram identifies the four tiers of the VE comprised of:

- VE-Ware
- VE-Toolkits
- VE-Gaia
- VE-Pro

For additional information on the four levels go to "How and when should I integrate performance analysis for sustainable design?"

The lower portion of Figure 1 identifies the different modules that a part of VE-Pro. For additional information on the different modules please go to - http://www.iesve.com/Software/VE-Pro

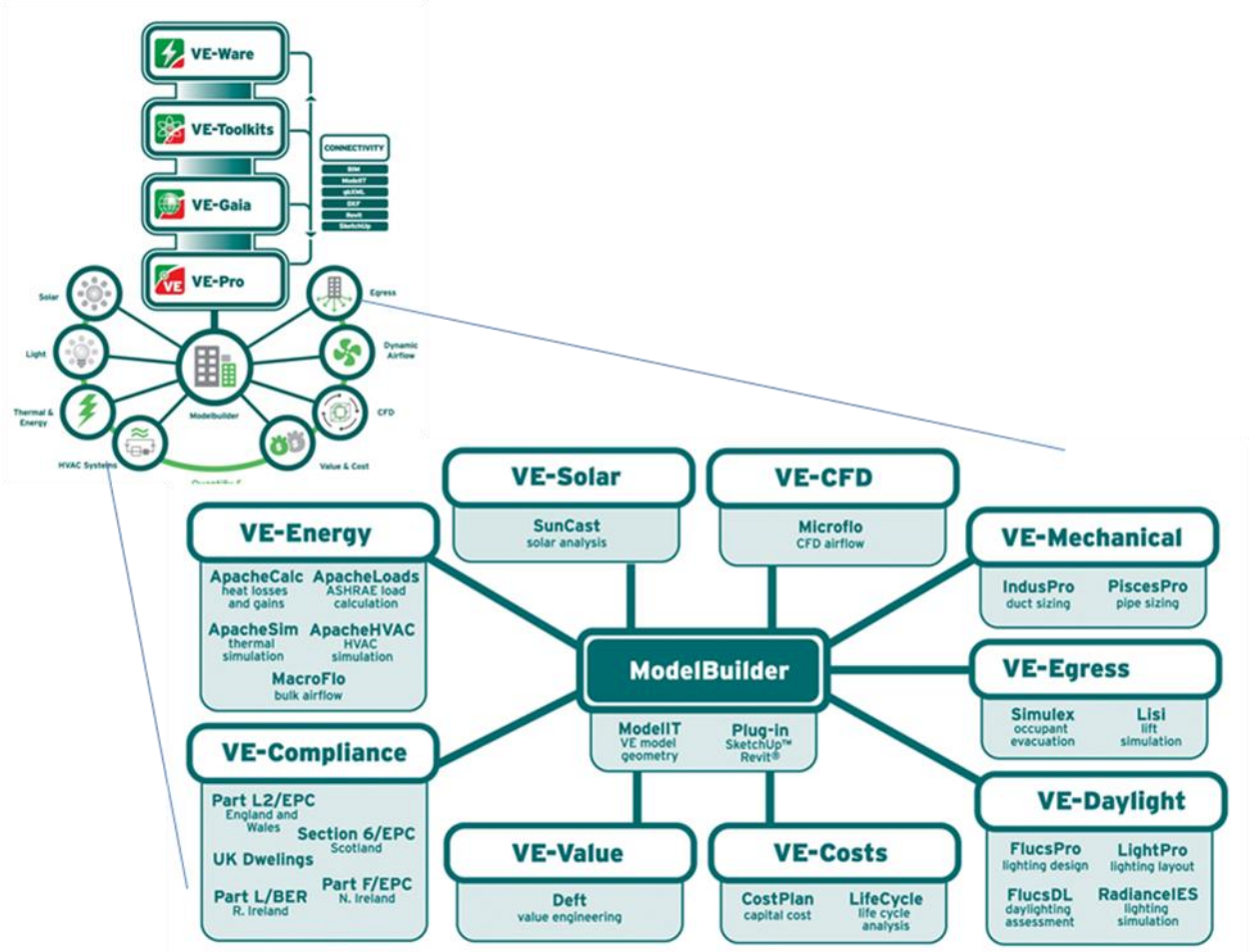


Figure 1 - The Four Levels of the VE and VE-Pro Modules

5. Preliminary Data Setup

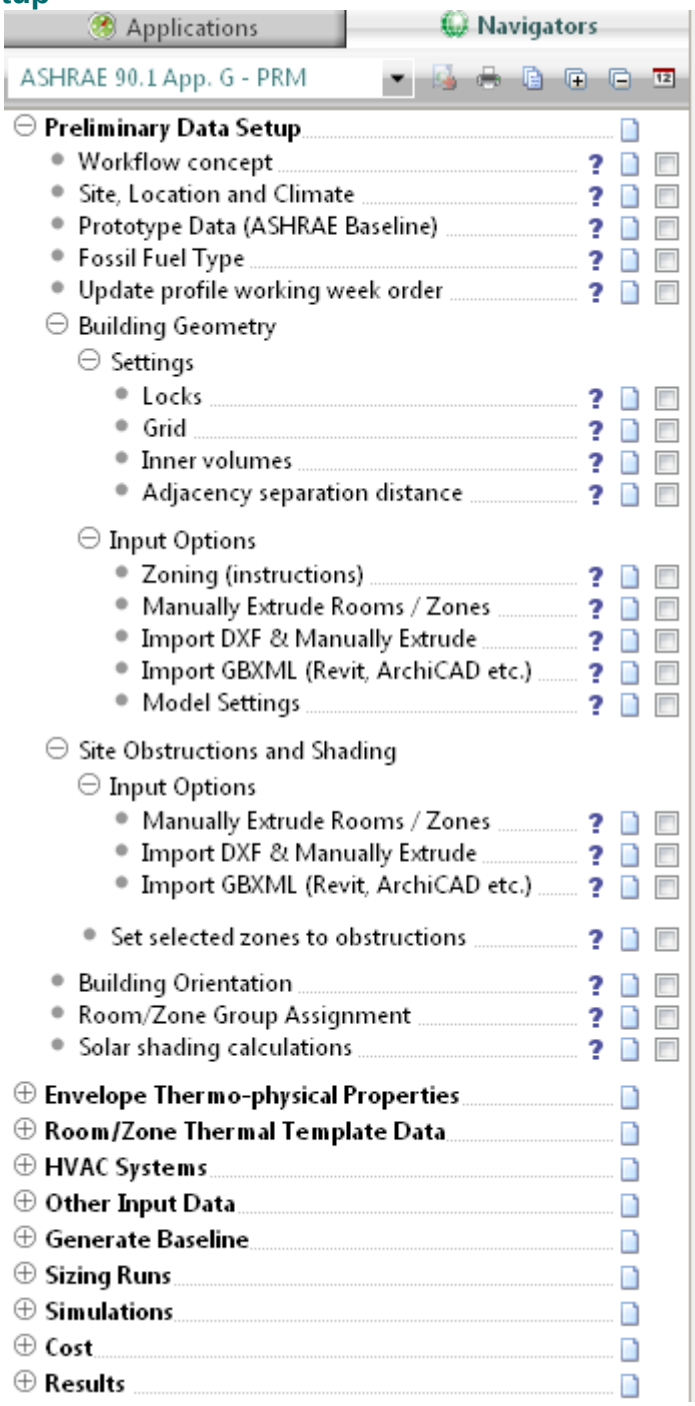


Figure 2 - Preliminary Data Setup Sub-Categories and Tasks

A few things to note that are consistent across all the sub tasks for each of the nine main category areas with the navigator

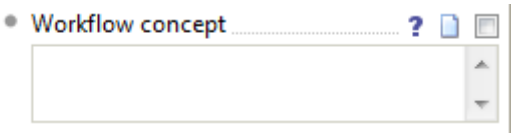


Figure 3 - Task Button Options

Each task line will have up to three buttons shown to the right:

- **?** – provides a link to 'help files' directly related to that task line
- **Notes icon** – when selected a 'notes field' will appear below, which allows the user to input specific notes related to that task for documentation purposes or to share with other team members
- **Check box** – provides users the ability to select and 'check' that task as complete. This can be important for personal or team tracking on a large or complex project.

Workflow concept

The hyperlink serves a 'help guide' and takes the user to a more detailed description of the workflow concept for the navigator, similar to the information contained within this document.

Site, Location and Climate

The hyperlink for this action opens the ApLocate sub-program from which the user then specifies the global location of the building (Lat.>Lon.), external design conditions and simulation weather file. This process is driven by clicking on the 'Selection Wizard...' and following the necessary steps:

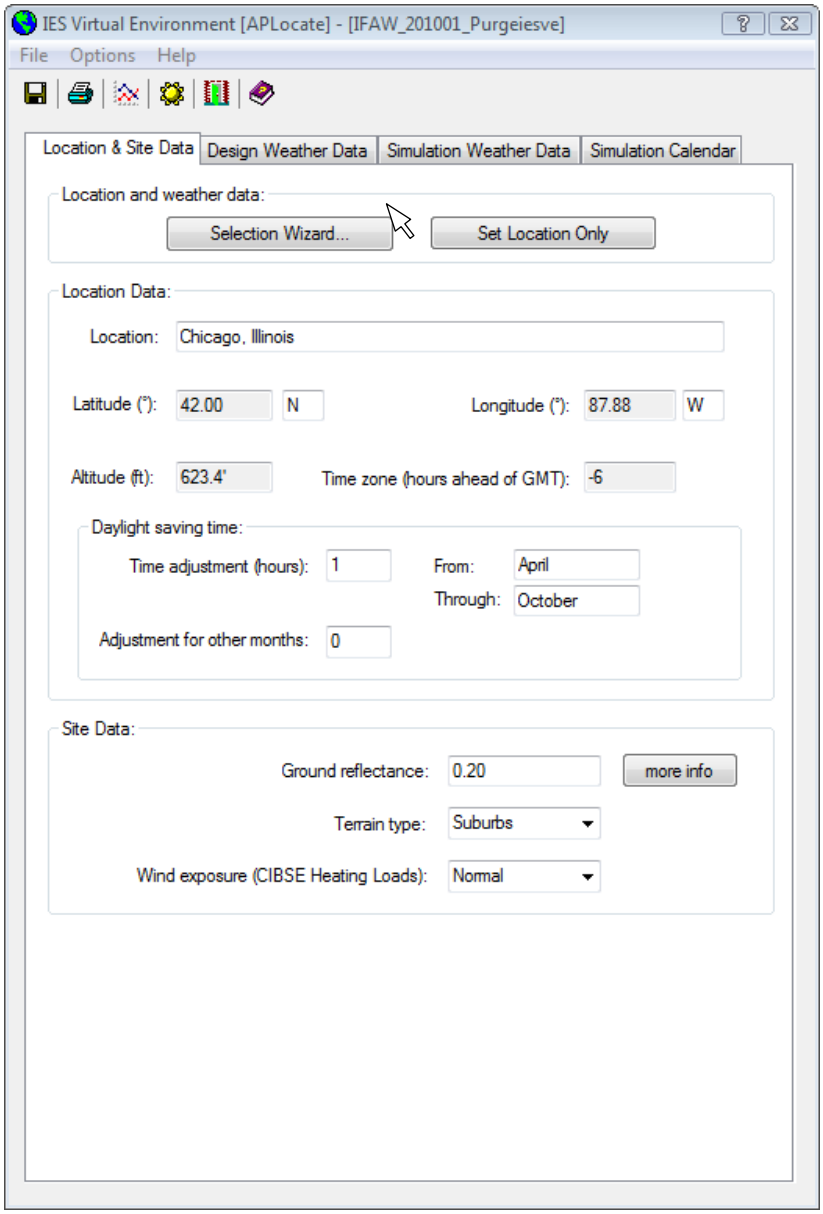


Figure 4 - Location Selection

There are four tabs associated with this dialog box:

- **Location & Site Data** – there are two options for selecting (Selection Wizard or Set Location Only) the climate file associated with the project.

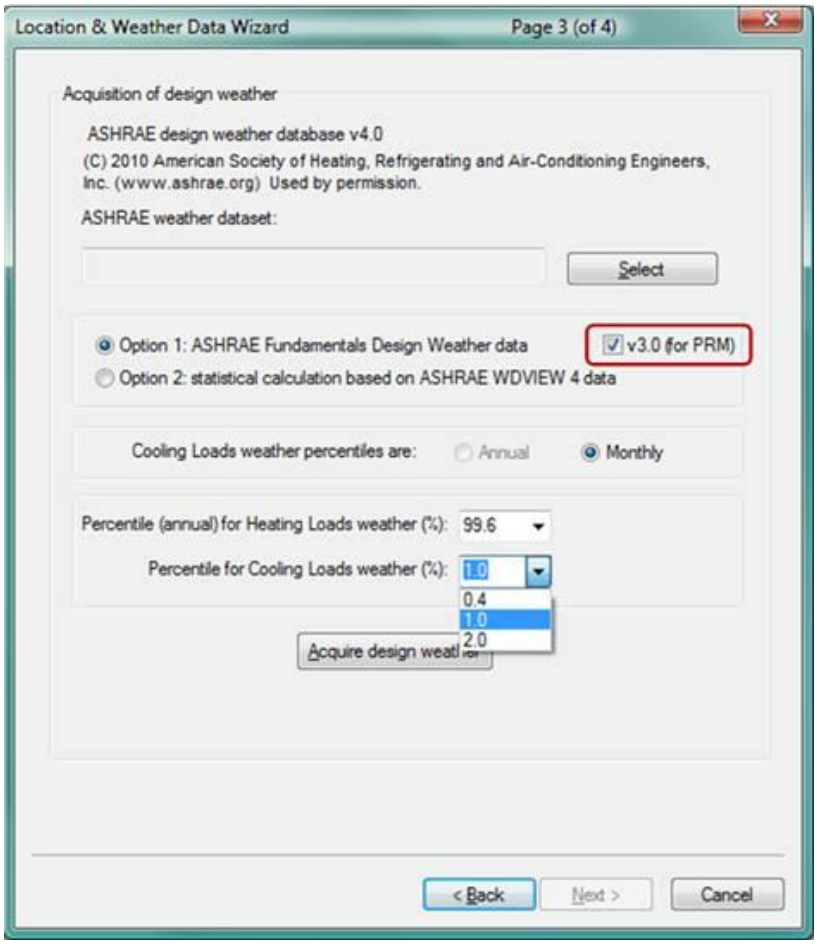


Figure 5.1 - Location Selection Wizard

Important Note: As the ASHRE 90.1-2007 and -2010 Appendix G PRM (Section G3.1.2.2.1 Sizing Runs) requires 1% Cooling Design conditions, but the newer ASHRAE Design Weather Database 4.0 does not include 1% data, all PRM users need to tick the box next to "v3.0 for PRM" in the Acquisition of design weather section (page 3 of 4) in the ApLocate Location & Weather Data Wizard. Then set the Percentile for Cooling Loads to 1%, prior to clicking Acquire design weather.

- **Design Weather Data** – provides feedback on the climate selected and the ability to review and customize key parameters of the climate selected. This data will be used for the Sizing Runs.
- **Simulation Weather Data** – Reports the weather file that ApacheSim will be utilizing for simulation runs. The file is selected based on the choices within Location & Site Data/Selection Wizard, however the user can also change the selection within this tab to browse and select a different weather file. This data will be used for the annual thermal/energy simulations.
- **Simulation Calendar** – provides the ability to select and customize 'a holiday template' (days considered to be holidays which could trigger different building operation setting) based on the country and other parameters.

Once the location is selected the climate file, which provides the input data for the hourly energy (8,760 hours) is determined. The VE actually runs the energy analysis on 6-minute time steps (as a default) versus hourly, so that the influence of thermal mass can be accounted for within the design.

Prototype Data (ASHRAE Baseline)

This command imports an ASHRAE 90.1 baseline data set which can then be used as a starting point for any PRM project. This is the most critical step in the PRM navigator as it essential gathers all the pre-created PRM information so that the navigator can function in its intended fashion. When the command is activated the software automatically imports a range of default ASHRAE data in a fully functional VE format, this information has been taken from 90.1 ASHRAE 90.1 & the ASHRAE 90.1 user guide. This allows a user to define the building based on the building type (for early stage analysis) or space type (for more detailed analysis):

- ASHRAE 90.1 Thermal Templates (Building Area Method or Space by Space Method)
For the Building Area Method, default data is derived from:
    - ASHRAE 90.1 Internal Gains (Occupancy, Lighting, Equipment)
-
- For the Space by Space Method, default data is derived from:
    - ASHRAE 90.1 Lighting power densities
    - ASHRAE 62.1 Occupancy densities
    - Title 24 ACM Equipment power densities
- Both methods use
    - ASHRAE 90.1 Profiles/Schedules (from the User's manual)
    - ASHRAE 62.1 Outdoor fresh air rates
    - ASHRAE 90.1 Envelope/Fabric Data (ASHRAE Climate Zone specific)
    - ASHRAE 90.1 Baseline Systems (1 to 8 +)

All of these defaults are editable to suit your actual project through subsequent steps of the navigator.

After the Navigator command has been activated the user must then select the "90_1_2007_IP" folder and subsequently select the associated VE .mit file.

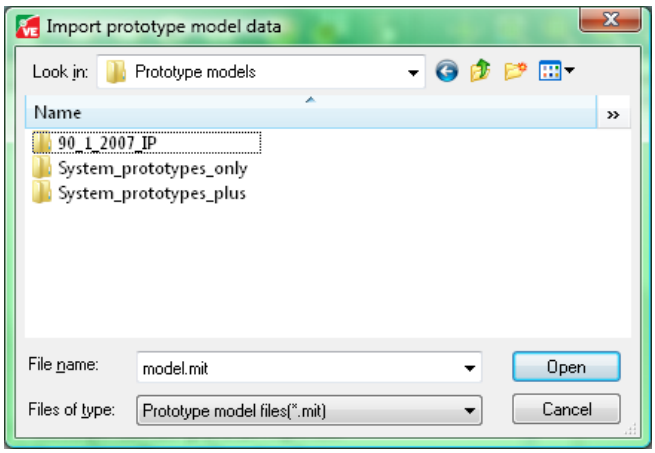


Figure 6 - Prototype Data Templates

Fossil Fuel Type

All miscellaneous fuel codes are assumed to be electricity except for:

- Space Heating
- Service Water Heating
- Cooking

This command allows the user to select the appropriate fuel type per energy use which will be subsequently used in the automatic generation of PRM results reportage in the Results section of the Navigator. This step is only important if these energy end uses are served by fossil fuels. If they are served by electricity and assigned the appropriate fuel code, this step is not necessary.

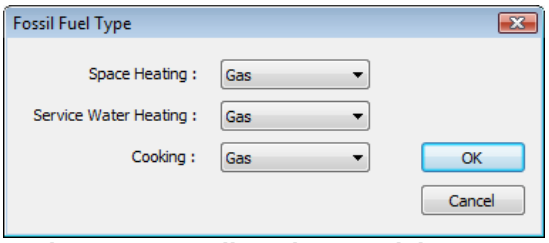


Figure 7 - Fossil Fuel Type Dialog Box

Update Profile Working Week Order

The hyperlink takes the user to the 'Profile Weekly Pattern Editor' which is used to dictate the daily operation of the building at a daily/weekly level. It allows the user to customize the operational days of their building to match the project requirements.

For example, in the Middle East region the typical working week is Sun-Thu with Fri/Sat being the weekend. In the UK/US however the working week is Mon-Fri with Sat/Sun being the weekend. This dialog allows the user to customise the weekly operation of their building.

An on/off filter is included which allows the weekday order re-shuffle/override to only be assigned to selected Profiles. The 'All' check-box allows a quick toggle to turn the entire list of profiles on/off.

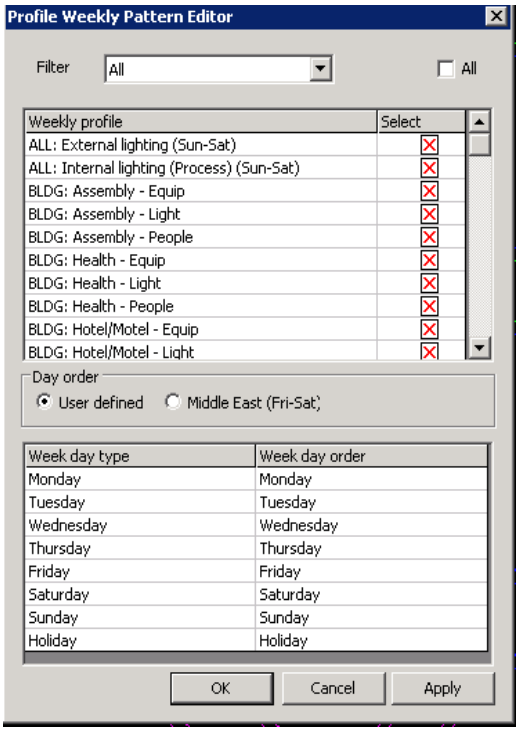


Figure 8 - Profile Weekly Pattern Editor Dialog

Building Geometry

Settings

Locks

Locks allow the user to snap the drawing tool to various items in the model view window such as model endpoint, midpoint, grid, etc. When creating model geometry it is useful to have the lock window open so you can switch different locks on and off depending on the particular modeling task you are trying perform.

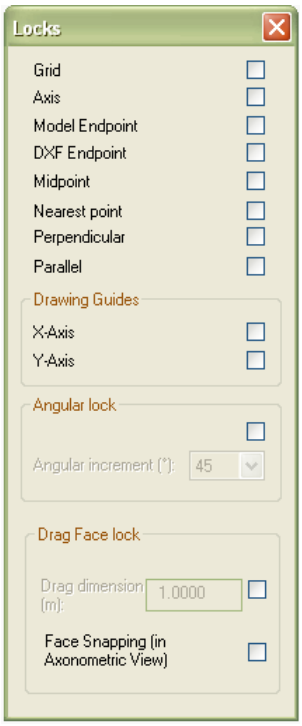


Figure 9 - Locks Dialog Box

Grid

Snapping to the grid when building model geometry ensures the creation of an accurate compact model which enhances accuracy and performance later in the analysis. This option allows the distance between grid points to be set - in both the x and y direction. Checking the grid box in the locks menu will force the drawing tool to snap to the grid. In general it is recommended to use a grid separation distance of 4 inches (0.1m).

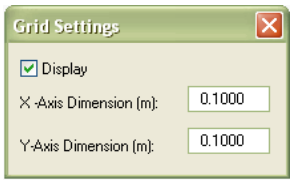


Figure 10 - Grid Settings dialog box

Inner Volumes

This option allows you to add or remove inner volumes from your model.

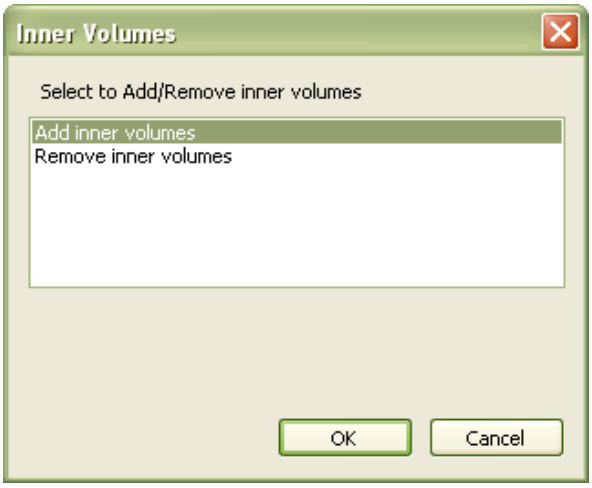


Figure 11 - Inner Volumes Dialog Box

Inner volumes are used to take account of the thickness of walls, ceilings and floors. The thickness of the walls will be defined later in the Apache Constructions Database. The thickness of the wall is represented in the model by a grey line which is offset into the room by the thickness of the wall. Inner volumes are only suitable for use in models with relatively simple geometry.

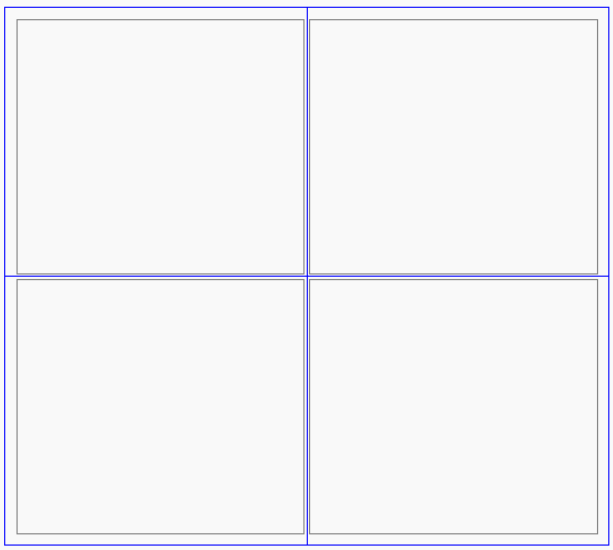


Figure 12 - Plan view of model separated into 4 inner volumes

Adjacency Separation Distance

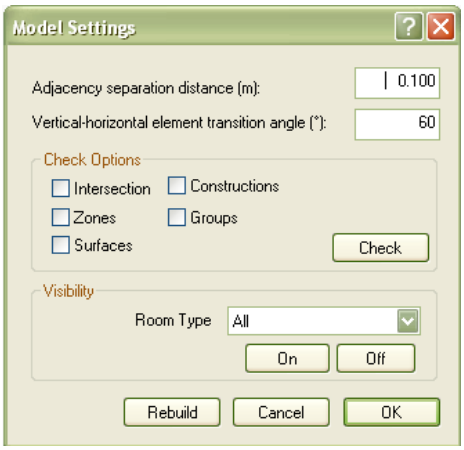


Figure 13 - Model Settings Dialog Box

This command opens the model settings window. Adjacency separation distance defines the maximum distance that two surfaces can be away from each other, while still being recognized by the software as being adjacent.

For example the two rooms in the image below on the right are 0.1m meter apart so the software would recognize them as being adjacent. Although in theory this is fine, in complex models it can cause errors to occur. It is recommended to always snap directly to the surface of the adjacent room as shown in figure below on the left. This can be done easily by using the 'Model Endpoint' lock.

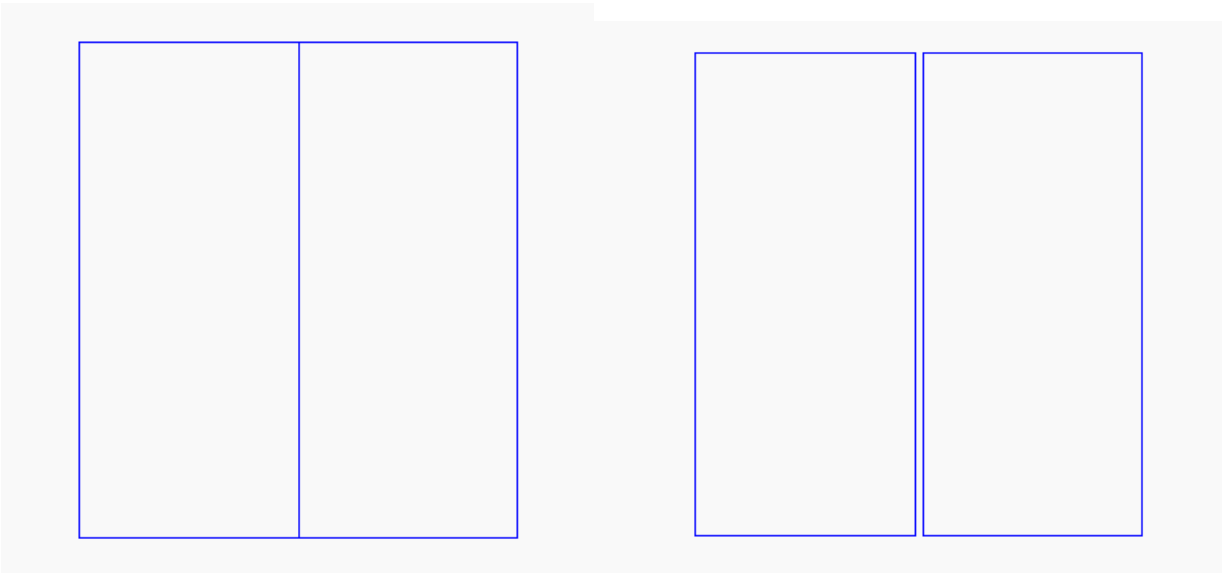


Figure 14 - Plan view example of room adjacencies

Input Options

Zoning (instructions)

Zoning is of critical importance to the model. Too many zones and the model becomes over complex, too few and detail is lost. Although the main focus should be on capturing core functional spaces e.g. offices in commercial buildings or living rooms, bedrooms etc. in residential buildings - it is also necessary to capture the area/volume of other miscellaneous/ancillary spaces such as elevator shafts, toilets, stairs etc.

The single most important aspect to note in relation to these space types is that they do not have to be represented exactly and individually to effectively convey the energy consumption of the building. In other words it is not necessary to model each and every space separately but instead zones can be outlined around each of these space types that capture all of a space type together.

The zoning (thermal block) requirements outlined in ASHRAE 90.1 Appendix G (proposed model thermal zones and baseline model thermal zones to be the same) should also be kept in mind when creating the building geometry. The details presented should be followed closely in order to meet the requirements of the Performance Rating Method.

As outlined in the concept document it is helpful that defined zones are broken-down as per the list of space types used in the prototype data:

TABLE OF ROOM NAMES (from groups)	
Commercial	**Residential**
Data Center	Bathroom
Elevators	Bedroom
Gym	Common circulation
Gym (Changing / Showers)	Corridor
Kitchen	Dining
Lobby	Elevators
Office	Kitchen
Office ceiling void	Living room
Meeting Room	Lobby
Parking	Parking
Prayer room	Services
Retail (Catering)	Store
Retail (General)	Void
Services	
Stairs	
Stores	
Toilets	
Void	

Figure 15 - Table of Room Names

These space types correspond exactly with the room thermal templates and provide some indication of what spaces should be grouped together.

Manually Extrude Rooms/Zones

Click the ‘draw extruded shape’ button and the ‘shape settings’ window will open. Set the height of the room and what plane the room sits on. You can name the room here or you can choose to name the room later by right clicking on it in the room list in the side bar. Draw the outline of a room by clicking on points in the model view window to define the room vertices. It is important to snap to the grid.

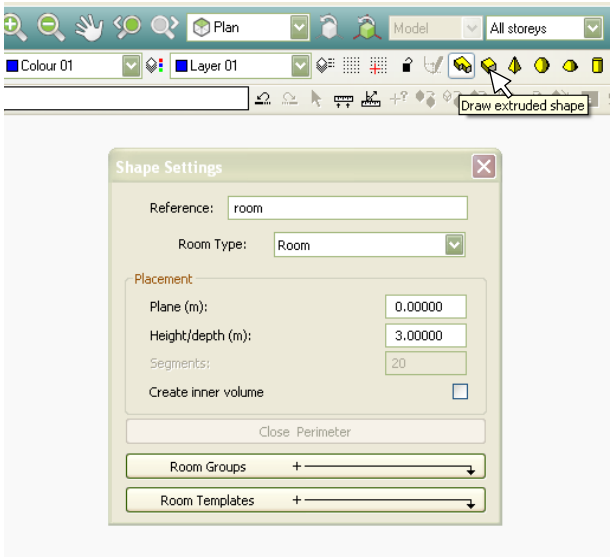


Figure 16 - Shape Settings Dialog for drawing shapes

Import DXF & Manually Extrude

When importing a dxf it is important to select the correct scale factor. The drawing will appear in grey in the model view window and will sit behind the model. Use this to as a guide in which to trace your rooms over while snapping to the grid at all times.

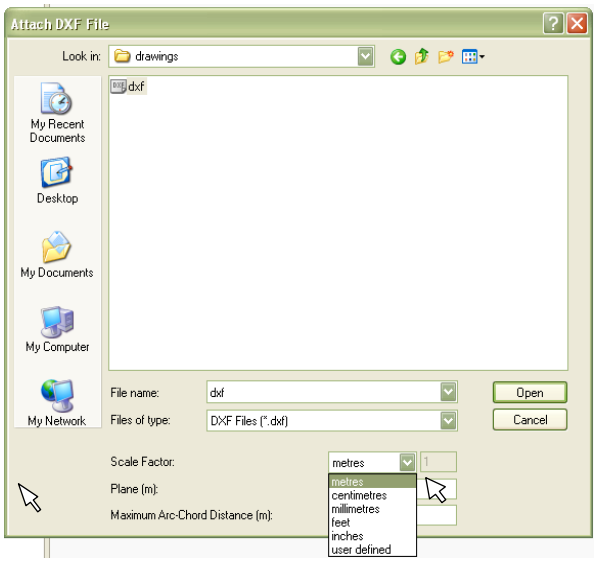


Figure 17 - Attach DXF file dialog

Import GBXML (Revit, ArchiCAD etc)

This hyperlink offers an alternative to manually building a model within the <VE> ModelIT module. It allows a .GBXML file to be imported from another CAD platform such as ArchiCAD or other.

Note: IES has developed plug-ins (can be downloaded at www.iesve.com) for the following BIM platforms that facilitate translating the model into the VE platform in enhanced ways compared to straight GBXML:

- *SketchUp and SketchUp Pro (version 6 & 7)*
- *Revit Architecture – 2009, 2010, 2011*
- *Revit MEP – 2008, 2009, 2010, 2011*

Model Settings

The model setting window allows you to change the adjacency separation distance, vertical-horizontal element transition angle and perform model checks.

Vertical-Horizontal Element Transition angle define at what angle a wall becomes a ceiling or a floor. By default, if a surface is at an angle less than 60° it is recognized by the software as a ceiling or floor.

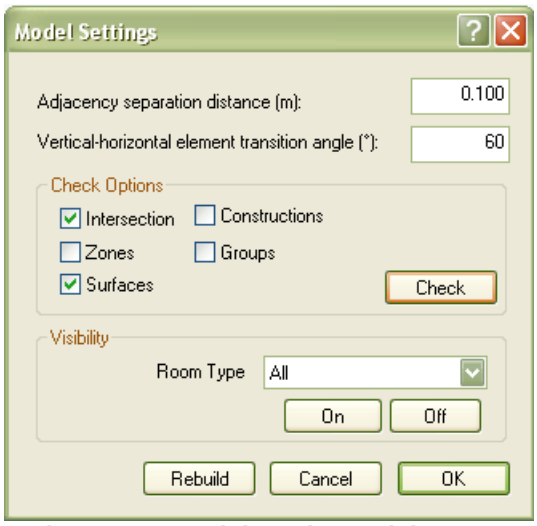


Figure 18 - Model Settings Dialog Box

The model check option allows you to perform a check on the quality/integrity of the geometry in your model. Check the boxes for intersections and surfaces and click the check button. A text file will be created which will flag up any error in your model geometry. It is recommended to perform model check regularly throughout the model building process. It is usually far easier to fix a geometry problem soon after it occurs rather than at the end.

Clicking the rebuild button refreshes all the adjacencies in the model.

Site Obstructions & Shading

Input Options

Manually Extrude Rooms/Zones

This command has no specific action and simply acts as a prompt giving the user the option of manually extruding zones from scratch. If this is the desired option then the standard ModelIT toolbar should be used to create zones by manually extruding in plan view. When all required zones have been created the Navigator check-box should be ticked confirming that the step has been completed

Import DXF & Manually Extrude

This command opens the 'Import .dxf' dialog and allows the user to place a .dxf as a trace layer within the ModelIT workspace. The user can then use the standard ModelIT commands to manually extrude zone geometry using the .dxf as a trace layer.

Import GBXML (Revit, ArchiCAD etc)

This command allows 3D .GBXML geometry to be imported directly from another CAD package such as Revit or ArchiCAD.

Set Selected Zones to Obstructions

All obstruction zones (i.e. non-thermal zones) should be selected before this hyperlink is selected. By subsequently clicking on the Navigator command the following dialog will appear:

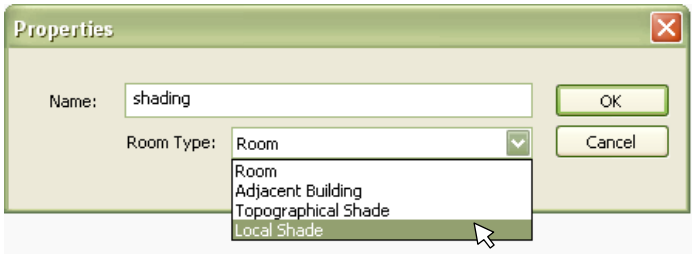


Figure 19 - Creating Obstructions Properties Dialog Box

The dialog allows the room type to be changed from "Room" to a suitable type of shading type. There are three types of shading:

- Adjacent Building
- Topographical Shade
- Local Shade

Building Orientation

This option allows the orientation of the building to be set. The arrow points in the direction of north and adjusts when a value is entered on the input line (default position = pointing straight up).

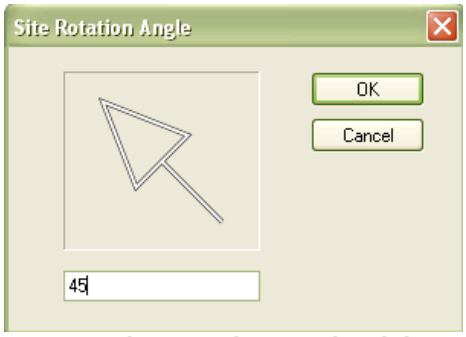
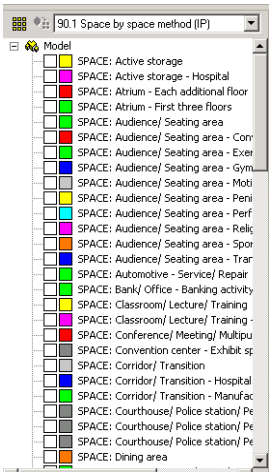


Figure 20 - Site Rotation Angle Dialog Box

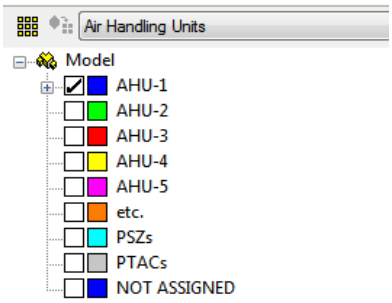
Room/Zone Group Assignment

In order to progress through the PRM navigator workflow in its intended fashion grouping of rooms becomes a critical step in the overall process. The assignment of thermal templates later on in the navigator relies on the correct grouping of room types. Also the configuration of HVAC systems also relies on the early stage grouping of rooms into AHU groups. This step in the navigator may not be applicable to all models as it may be just as easy to manually assign model zones to the relevant prototype grouping schemes.

When the prototype data is imported into the working model, it contains a series of thermal room groups based on ASHRAE 90.1 'Building Area' & 'Space by Space' methods. The user must choose to either group the zones by either 'Building Area' OR 'Space by Space'. If the 'Building Area' method is chosen then in the 'Space by Space' grouping scheme all zones must be placed in the 'NOT SPACE' group. Similarly if the 'Space by Space method is chosen then in the 'Building Area' grouping scheme, all zones must be placed in the 'NOT BLDG' group. The 'Building Area' method is generally used for early stage analysis where the exact function of every zone in the building has not yet been determined. The 'Space by Space' method is used more often as it allows the user to assign a particular function to each zone in the building.



It is advisable to also group rooms in terms of which AHU they are supplied by. This step is not essential but it will make it quicker and easier to assign rooms to their required HVAC systems later on.



The prototype data also contains additional grouping schemes that may be relevant to the users project needs.
The 'Word Search Grouping' tool is used to place rooms (thermal zones) into room groups.

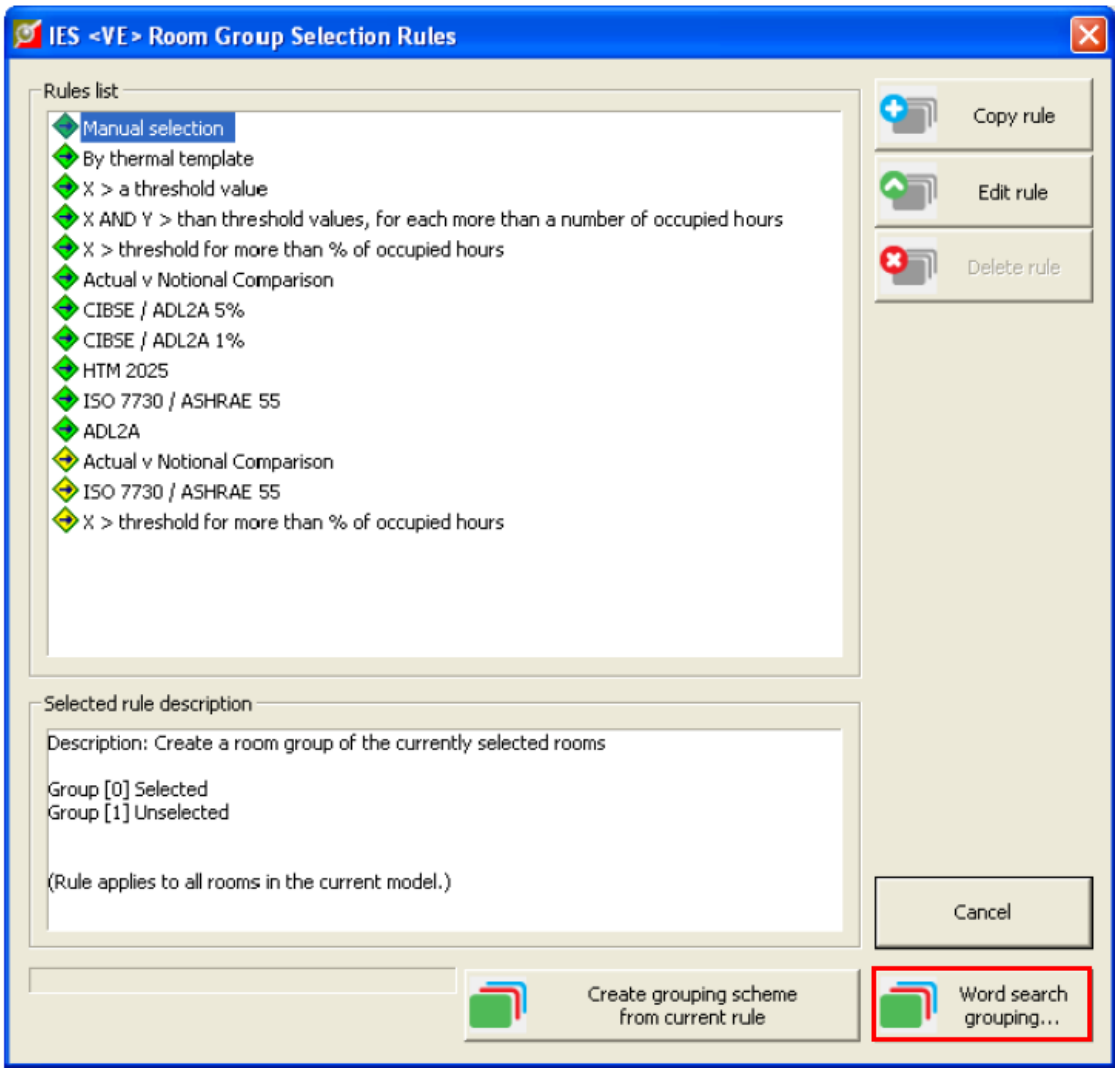


Figure 21 - Room Group Selection Rules Dialog Box

The grouping schemes that exist in the project must be extracted into the room group creator, by selecting ‘extract’.

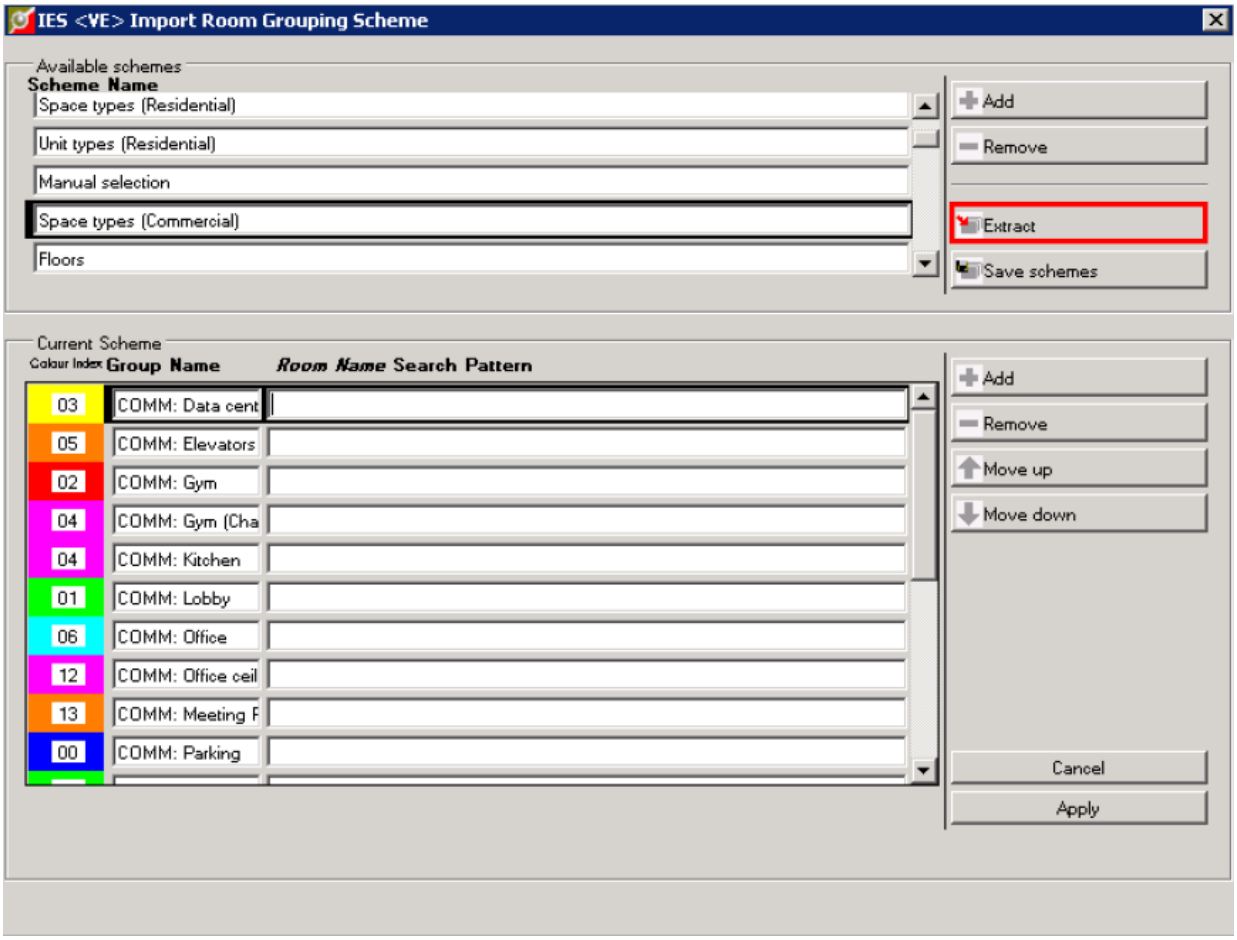


Figure 22 - Import Room Grouping Scheme Dialog Box

Depending on the naming convention used, common words are placed in the ‘Room Name Search Pattern’ dialog for each group. This name search uses the Perl regular expression syntax – see the user guide ‘PatternBasedGrouping.pdf’ for further information.

In this example the rooms have been named using the convention detailed in the ‘room / zone names’ help section of the navigator and thus general terms like, office, retail, lobby, etc can be used to easily sort the rooms into their appropriate group.

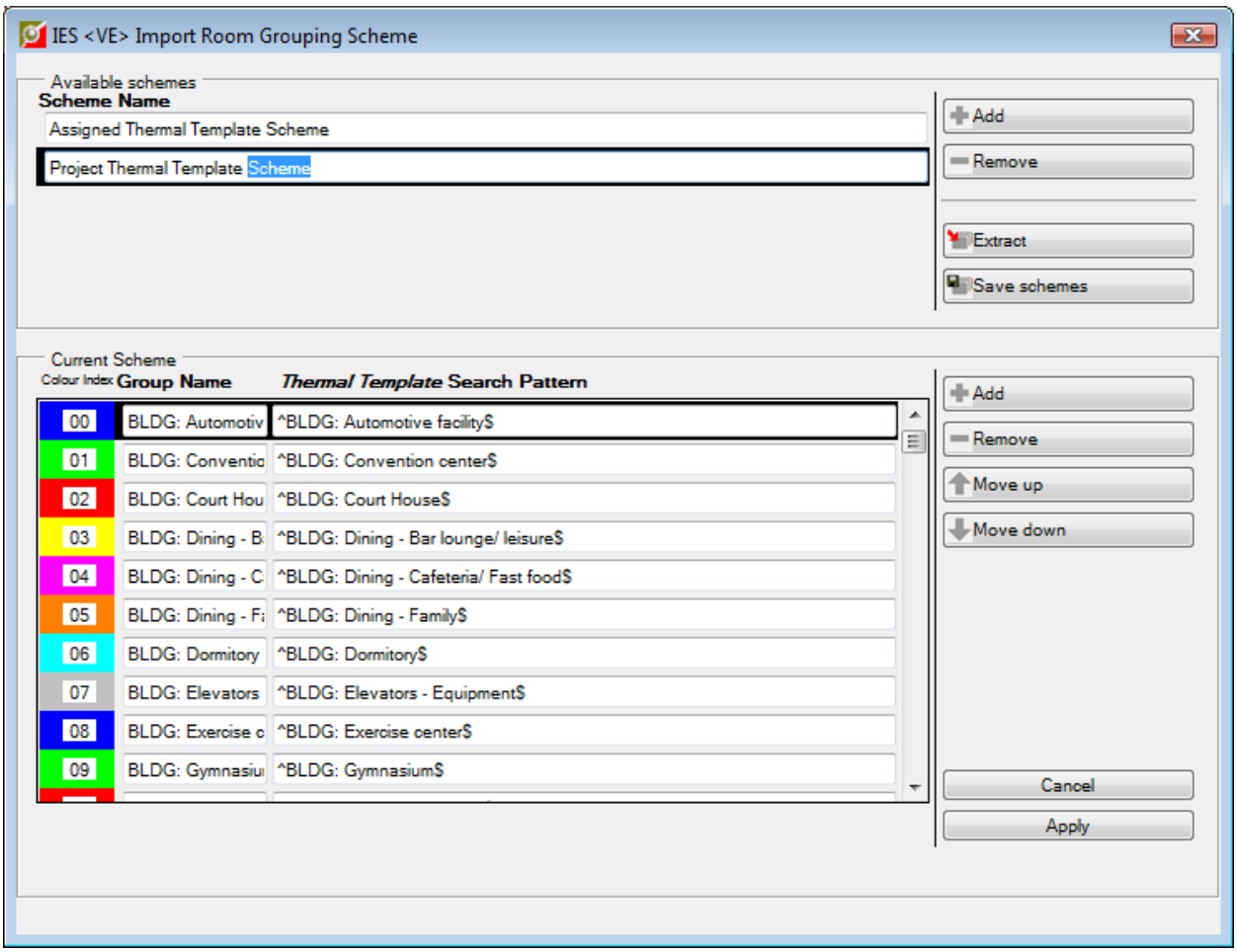


Figure 23 - Room Group Naming Example

Clicking 'Apply' then places the appropriate rooms into their associated room groups.

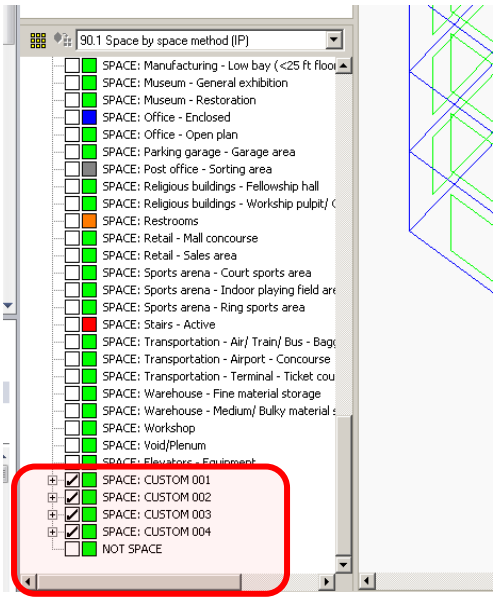
Figure 24 - VE Model Structure view of Room Groups

If residential rooms exist in the model, this process needs to be repeated for the 'Space types (Residential)' room group.

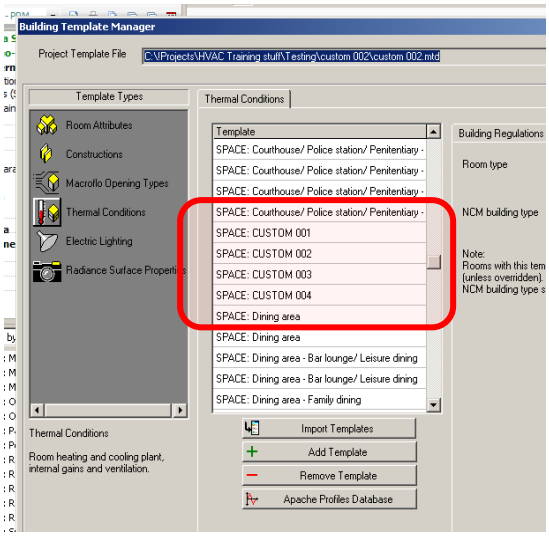
Creating Custom Templates

It may be necessary for users to create project specific custom thermal templates if the Prototype ASHRAE templates do not match all space types in the concerned model. In order to do this users must add additional room groups to the prototype grouping schemes & also create corresponding thermal templates. The group name & thermal template name must match in order for the “space classification” step to work correctly. Custom templates should be created prior to activating the “space classification” command. “Custom” templates must be manually assigned to the custom grouping schemes. See steps below;

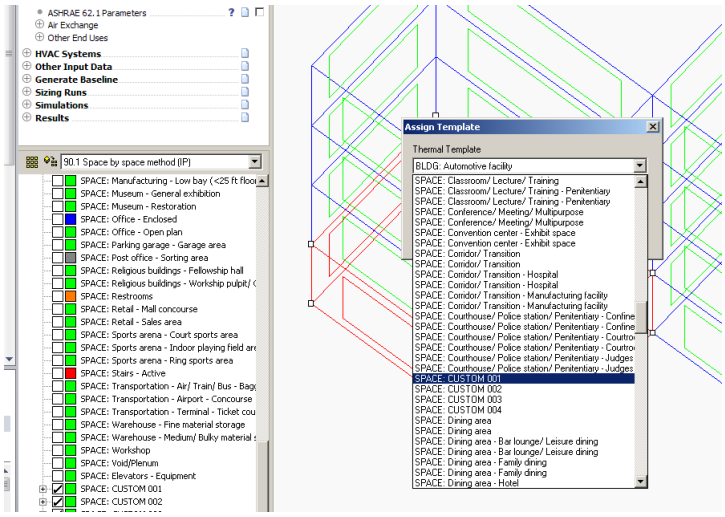
1. Add custom groups to ASHRAE 90.1 space by space prototype grouping scheme.



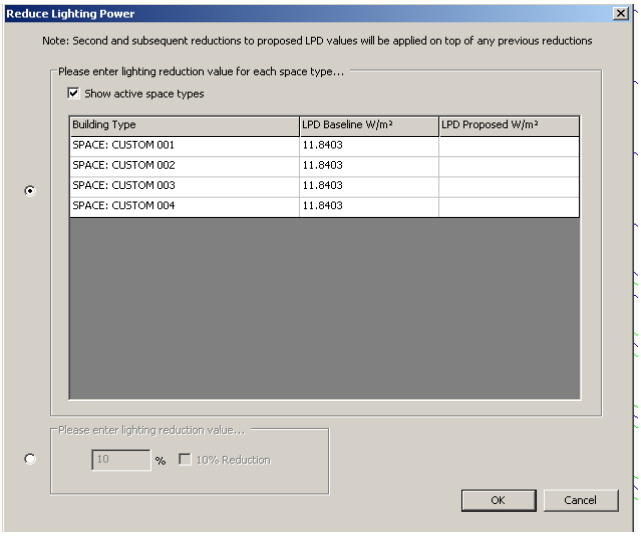
2. Create custom thermal templates in building template manager & setup custom template data i.e. internal gains etc.



3. Manually assign custom created thermals to custom created groups.



4. Once the “space classification” is activated all thermals will be assigned as per there corresponding room group. Once the internal gain “Light” step is activated all custom assigned templates should appear.



Note: Baseline lighting, equipment & occupancy data should be added to the custom made templates as per ASHRAE 90.1 2007 requirements.

Solar Shading Calculation

Clicking this hyperlink automatically opens the SunCast module and performs solar shading calculations. Solar shading calculations are performed hour by hour for the 15th day of each month of the year. These results will be fed into the Apache Dynamic Thermal Simulation as a simulation link.

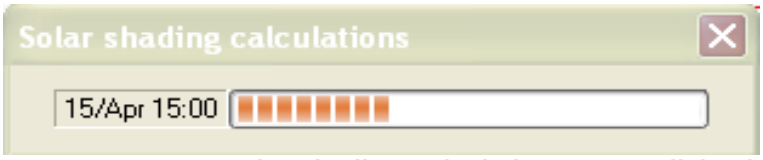


Figure 25 - Suncast Solar Shading Calculations status dialog box

6. Envelope Thermo-Physical Properties

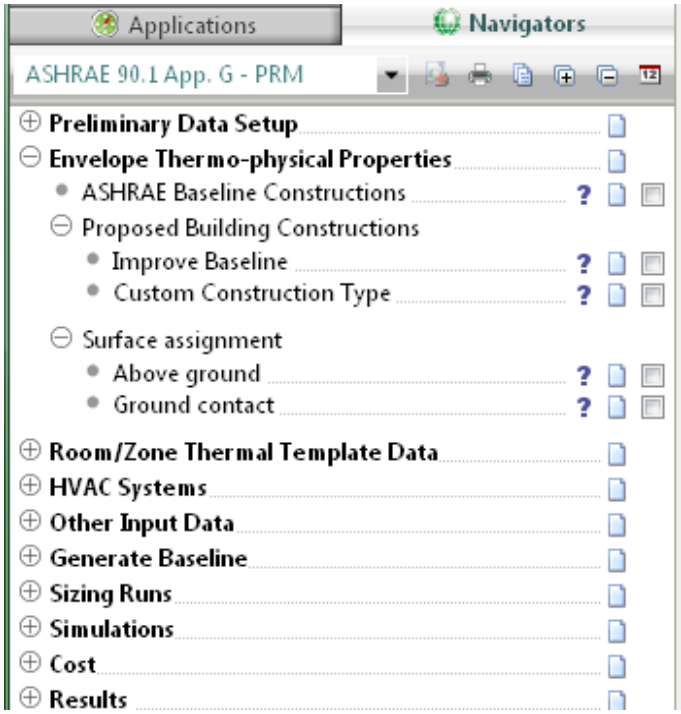


Figure 26 - Envelope Thermo-Physical Properties Sub-categories and Tasks

This navigator category consists of a number of sub-categories and tasks designed to take users through the process of assigning ASHRAE baseline & proposed building envelope information.

Essentially users are prompted to follow three main steps;

1. set baseline construction requirements
2. create proposed model constructions
3. Assign proposed model constructions for both above & below ground surfaces

ASHRAE Baseline Constructions

Step 1: The user must first select the Building Type (residential, Non-residential or semi heated)
Step 2: Subsequently both Opaque & Fenestration construction category types must then be selected from the provided drop down boxes. By pushing the 'ok' button pre-defined construction materials will then be imported into the ApCdb construction data base manager, with default values corresponding to the relevant ASHRAE Climate Zone requirements.

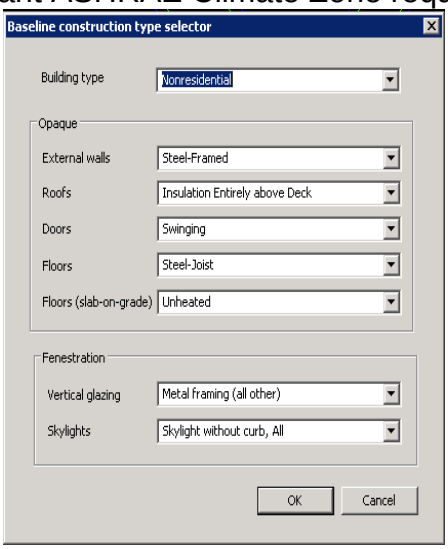
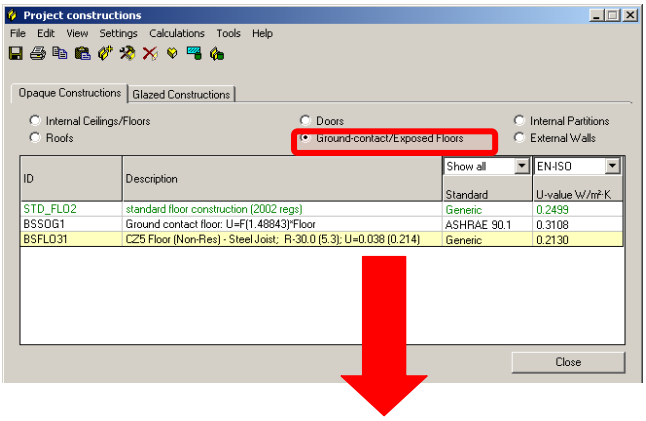
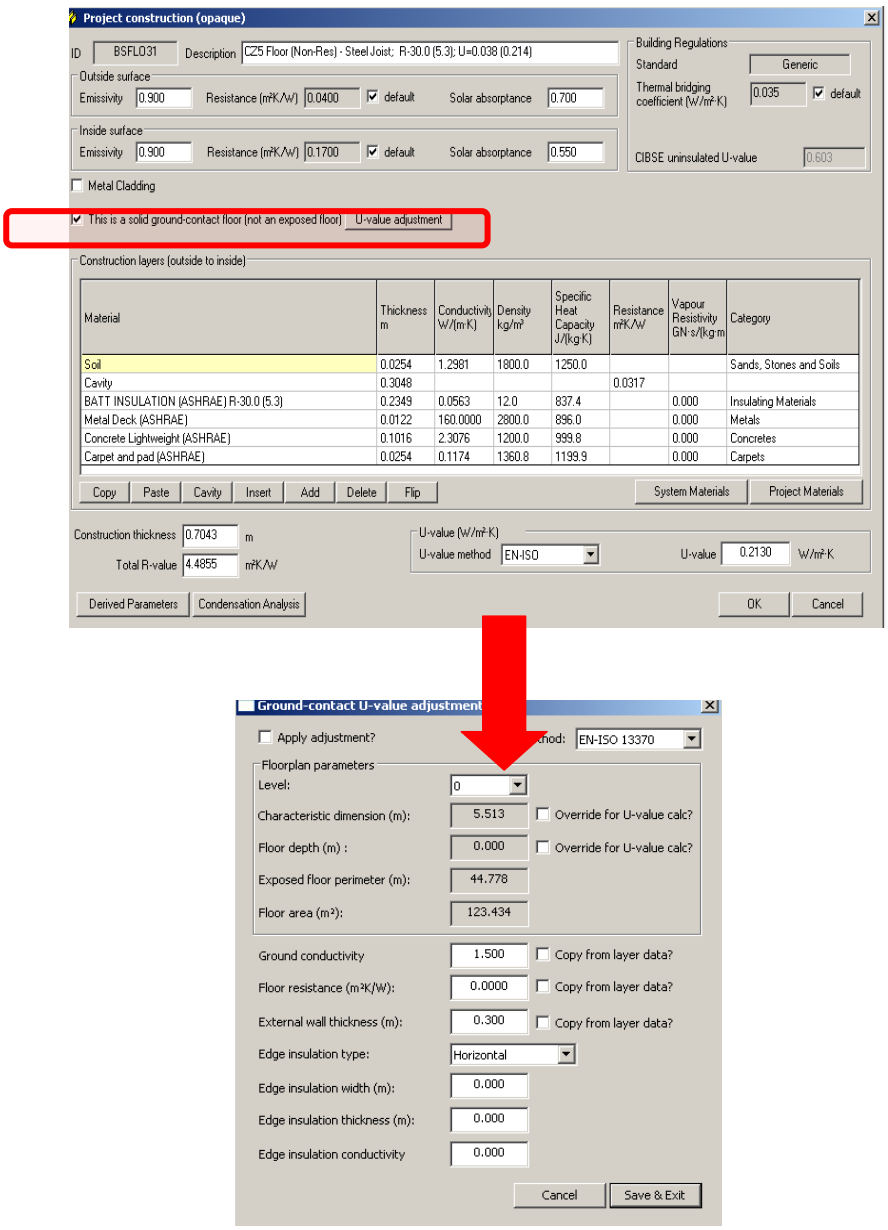


Figure 27 - Baseline Construction Type Selector Dialog Box

Note: If a US climate zone location has been selected back in the 'site, location & climate' step the relevant ASHRAE 90.1 baseline construction will be automatically imported into the ApCdb construction data base manager'.

Manual edits must be made to the baseline ground floor construction type in order to account for ground contact factor, see below;





The ground floor contact U-value adjustment interface should be populated accordingly. For further information refer to the “Apache Cdb User Guide”.

Proposed Building Constructions

Within this section the user can choose to assign proposed building constructions from one of two options.

Improve Baseline

The user can choose to select & edit any default ASHRAE 90.1 baseline construction type for use in the proposed model. Clicking the “Show Baseline” button will display a list of the baseline constructions, so you can assess how your proposed construction compares to the baseline requirements.

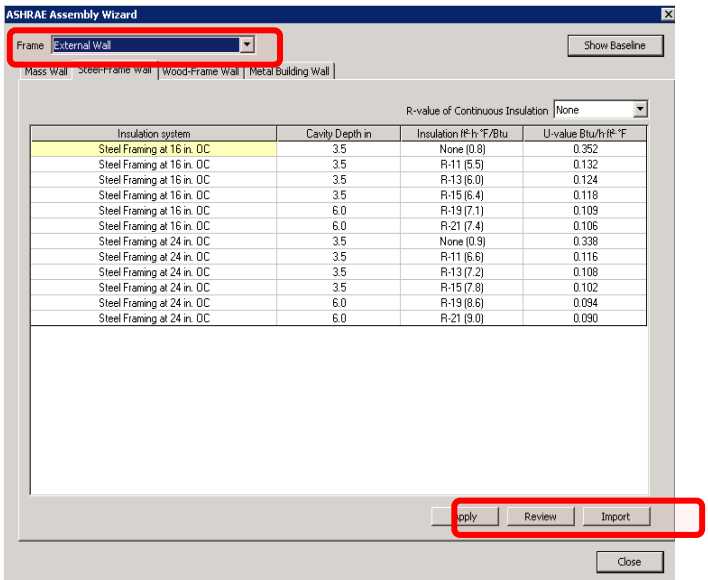


Figure 28 - ASHRAE Assembly Wizard Dialog Box

Improved baseline constructions for use in the proposed building can be imported into the ApCdb construction data base manager once manual edits have been made. Note that a copy will be made for the proposed building and the baseline construction itself will not be edited. Clicking the “Apply” button will automatically assign your improved construction assembly to the entire proposed building.

Custom Construction Type

Alternatively the user can choose to create proposed building envelope constructions as per known project specifications. When choosing this option the user is taken straight to the ApCdb construction data base manager were they can create custom construction types for the proposed model from scratch.

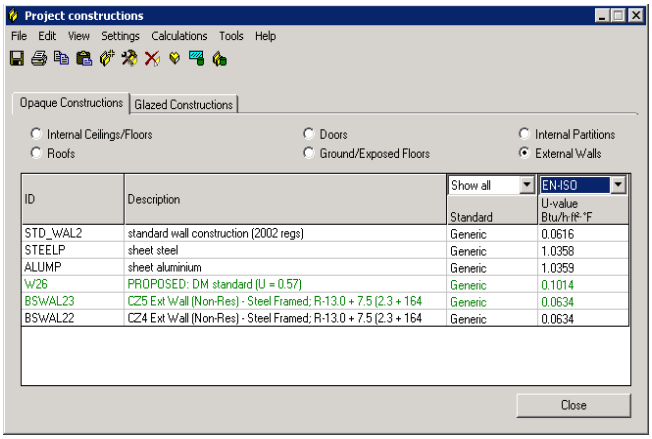
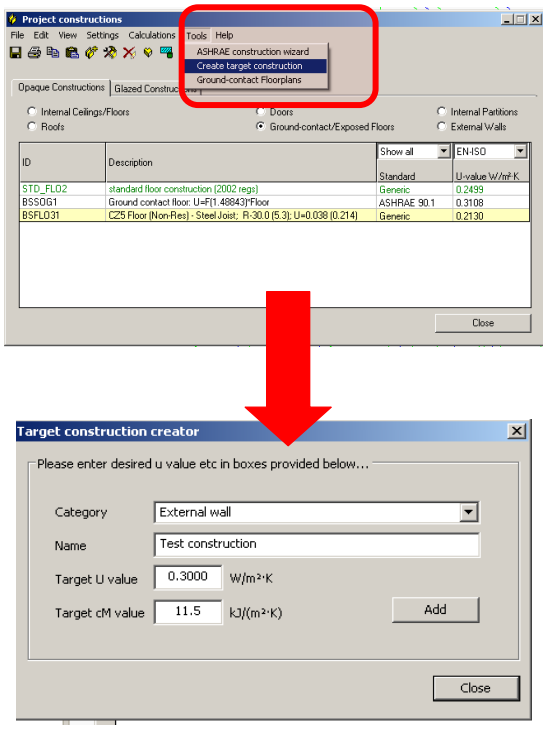


Figure 29 - Project Constructions Dialog Box

Note: For future reference when using the VE. The line items in the dialog above that are highlighted in green mean that those external wall types (in this case) are being used in the model.

Alternatively the "create target construction" option could be selected if detailed proposed construction information is not available, see below;



This feature allows users quickly create construction types with minimum effort for early stage analysis.

Surface Assignment

This command allows the user to assign proposed construction types to model surfaces. Note that baseline constructions will be automatically assigned to the baseline model once created (later step in the PRM Navigator Process).

Above Ground

Assign above ground proposed constructions

Ground Contact

Assign below ground constructions. (As per ASHRAE 90.1 calculation method)

7. Room/Zone Thermal Template Data

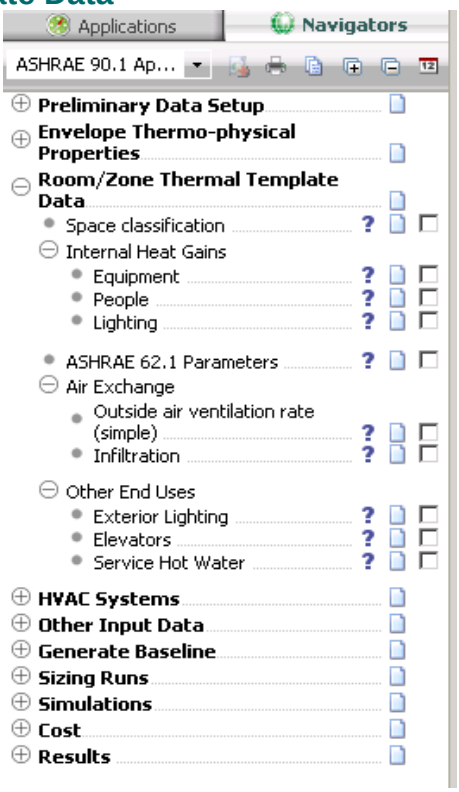


Figure 30 - Room/Zone Thermal Template Data - Sub-categories and Tasks

This navigator stage consists of a number of sub steps that take the user through assigning thermal template information to the Proposed & baseline models.

Space Classification

This step assigns building thermal template information to the proposed model based on the selected thermal template scheme—i.e., the Building area method or Space by space method. This step is closely linked to the “Room/zone Group Assignment” step. Therefore, all spaces in the model must first be assigned to the appropriate groups in either the BLDG or SPACE grouping schemes. This can be done manually or with tools provided in the “Room/zone Group Assignment” step. This step essential performs a global assignment of thermal templates.

Note that you must decide whether to use the Building Area Method OR the Space by Space Method, not a combination of the two. If you opt for the Space by Space method, then ensure that the room group assignment under the building area method is “NOT BLDG”. If you opt for the Building Area method, then ensure that the space by space room group assignment is “NOT SPACE”

The Building Area Method is generally used for early stage analysis where the exact function of every zone in the building has not yet been determined. The Space by Space Method is used more often as it allows the user to assign a particular function to each zone in the building.

Internal Heat Gains

Set Proposed internal gains.

Note: Equipment & People gains should remain the same in both the proposed & baseline models.

Equipment

Baseline & Proposed equipment loads should remain the same except in special cases. Editing the baseline column will apply changes to both models. Editing the proposed column will only edit the proposed model and a message will appear alerting the user that differences in equipment gains between the baseline and proposed must be justified with supporting documentation to the entity reviewing the energy model.

People

Baseline & Proposed equipment loads should remain the same. Editing the value in this dialog will apply the edit to both the proposed and baseline models.

Lighting

Set proposed lighting power densities for space types. The default values provided for the baseline model are in line with the values in ASHRAE 90.1-2007 Chapter 9 Lighting within:

- Table 9.5.1 Lighting Power Densities Using the Building Area Method

- Table 9.6.1 Lighting Power Densities Using the Space-by-Space Method

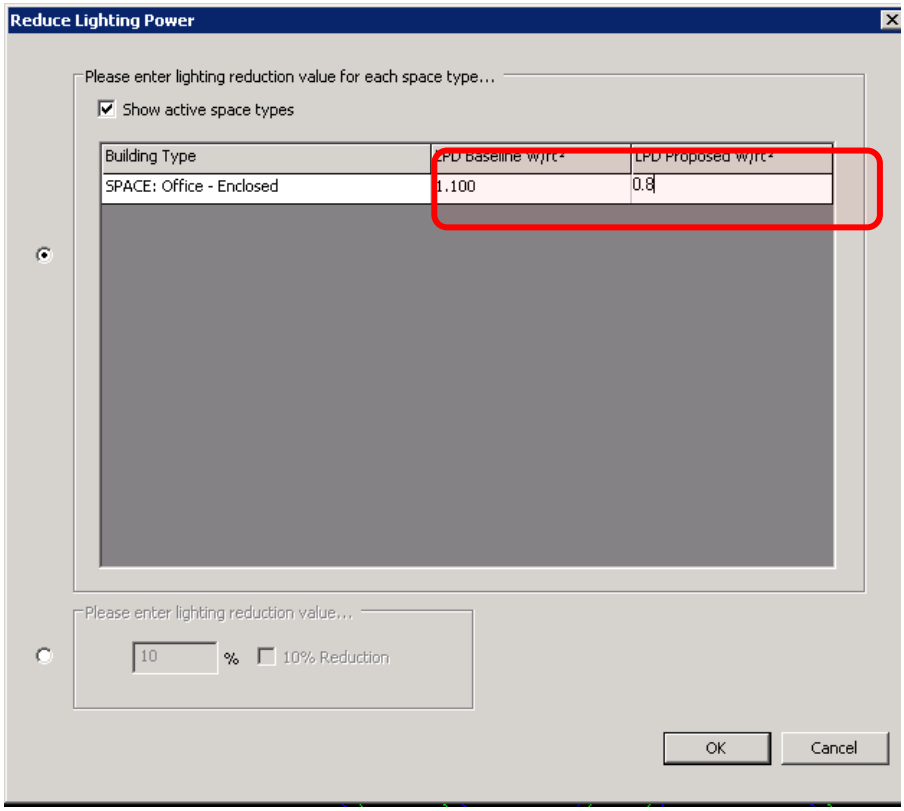


Figure 31 - Reduce Lighting Power - Proposed Manual Value Entry

The dialog above shows the first way that the Lighting Power Density (LPD) can be input for the Proposed Design model through direct entry of a value on the far right column (LPD Proposed W/ft2) for each space type.

Note that the LPD Baseline W/ft2 default value shown for each space or building type aligns with the ASHRAE 90.1-2007 Chapter 9 Lighting tables identified above.

A second approach to establishing the LPD Proposed W/ft2 is shown in the figure below. The user can either directly enter a "% value" (1-100) in the input cell under 'Please enter lighting reduction value' or if targeting a 10% reduction can just select the 'check box' to the right of the input cell. By providing an input in either one of these ways the LPD Proposed will be derived by taking the LPD Baseline value and multiplying it by (100% - the lighting reduction %). Subsequent entries into the "% reduction" field will reduce the current proposed value by that percentage. If you desire to test alternate reductions compared to the baseline, then reset the proposed LPDs in the top section to match the Baseline, press OK, and then reopen the dialog and enter a new % reduction.

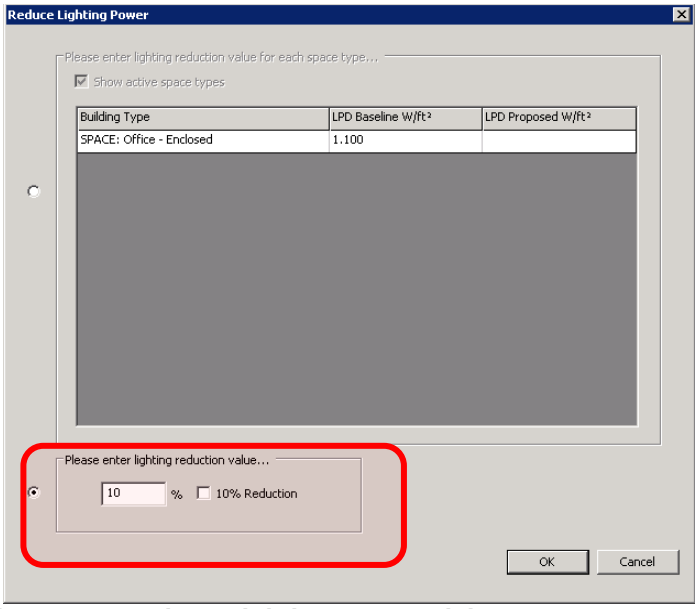


Figure 32 - Reduce Lighting Power Dialog - Custom Inputs

ASHRAE 62.1 Parameters

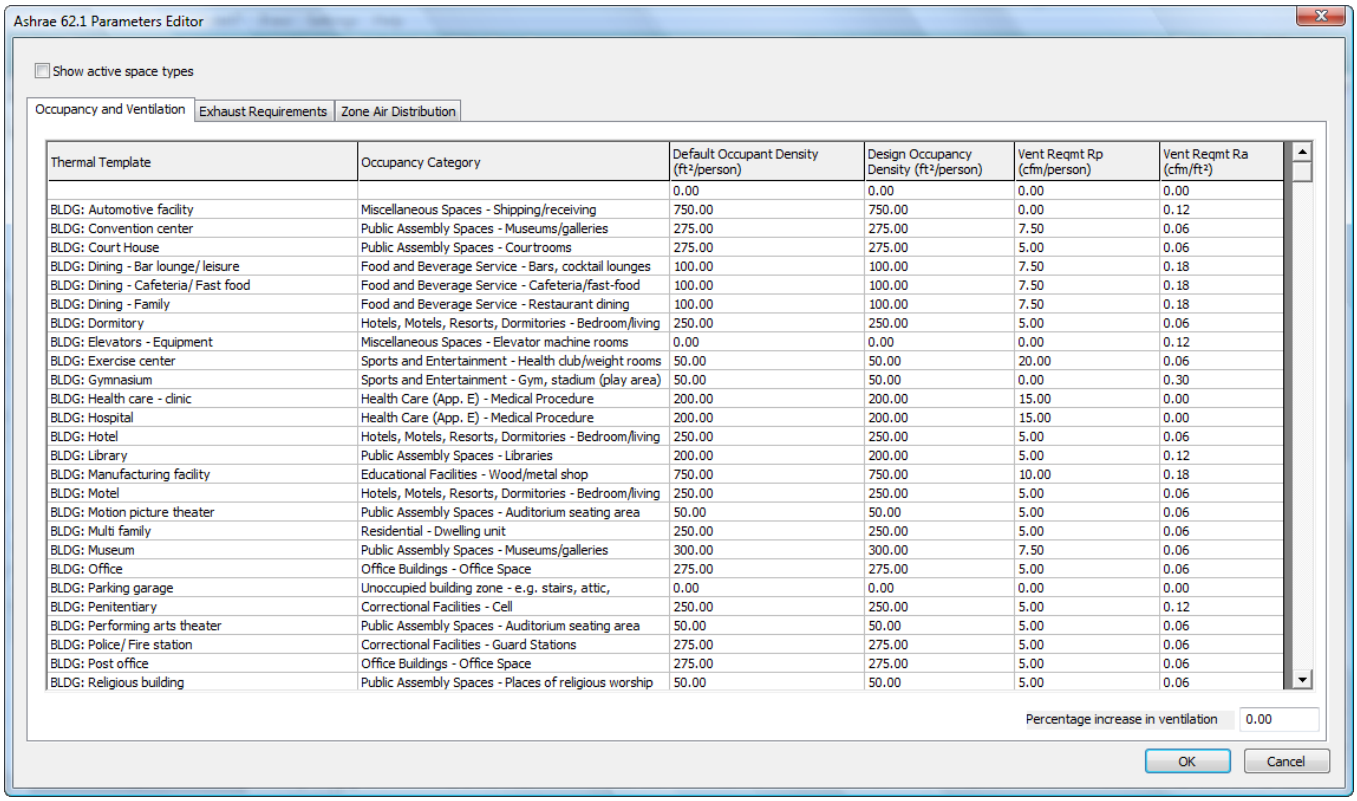
The hyperlink opens the ASHRAE 62.1 Parameters Editor (figure below), which is composed of three tabs and shows all Building and Space options available. In the upper left hand corner the user has the ability to select the check box for 'show active space types' to isolate just those utilized within the model. The three tabs include:

- **Occupancy and Ventilation** – provides the parameters for each line item that serve as the inputs into the ventilation calculations for the model. The user may select an alternate 62.1 occupancy category for each thermal template if they desire by picking from the drop down menu. The "Default Occupancy" column is not editable – this is the default occupancy level as per the ASHRAE 62.1 standard for each occupancy category. The "Design Occupancy" column can be edited if your proposed building has a different occupancy. Note that any previous edits to occupancy under the "Internal Heat Gains" will be reflected here. Edits here will also be reflected in the Internal Heat Gains/People window. Values for Ra and Rp are derived based on 62.1 Table 6-1.
    - Percentage increase in ventilation – on the lower right side of the dialog box the user can enter a custom value (1-100%) for the percentage increase in ventilation. After inputting a value and hitting 'ok' the percentage increase input is applied to all the line items included on this tab. This may be useful if the project is attempting to achieve LEED EQ Credit 2.
- **Exhaust Requirements** - provides the parameters for each line item that serve as the inputs into the ventilation calculations for the model. The user may select an alternate exhaust rate category if they desire by picking from the drop down menu. This will update the exhaust flow rates accordingly as per 62.1 Table 6-4. Edits may be applied to the "exhaust per unit" column if this is how they are specified in Standard 62.1 (restrooms, residential kitchens). Customized exhaust flow rates may be specified by selecting "User specified exhaust rate" as the exhaust rate category, and editing one field to specify the rate in terms of cfm/sf, ACH, or exhaust per unit/# of units. A user may also specify whether exhausted zones are served by 100% transfer air or not. If "Y" is selected, that zone will not have any system supply air but will be served by transfer air only.

- **Zone Air Distribution** – Provides the parameters for each line item influencing the system design and ventilation calculations. The values can be manually edited within this tab. The "Mandated Supply Air Flow" column should be edited if a zone must receive a specific number of air changes (e.g. hospitals, laboratories, etc.). The Min SA Flow columns should be edited for VAV spaces. Min SA can be specified in terms of % of max, or cfm/sf. If values are input in both columns, the larger of the two will be used. The values for Ez should be input as per 62.1 Table 6-2 and are based on your system design. Note that the baseline model will always use 0.4 cfm/sf for the VAV turndown, and Ez values of 1.0 for cooling and 0.8 for heating as required by 90.1.

Note: If the user has not yet applied the ASHRAE Prototype Data using the 'Prototype Data (ASHRAE Baseline)' hyperlink then the ASHRAE 62.1 Parameters Editor will not appear.

Note: If the user has not yet applied zoning to the model using the hyperlink 'Room/Zone Group Assignment' then when the 'show active space types' check box is selected all the inputs will disappear.



Thermal Template	Occupancy Category	Default Occupant Density (ft²/person)	Design Occupancy Density (ft²/person)	Vent Reqmt Rp (cfm/person)	Vent Reqmt Ra (cfm/ft²)
		0.00	0.00	0.00	0.00
BLDG: Automotive facility	Miscellaneous Spaces - Shipping/receiving	750.00	750.00	0.00	0.12
BLDG: Convention center	Public Assembly Spaces - Museums/galleries	275.00	275.00	7.50	0.06
BLDG: Court House	Public Assembly Spaces - Courtrooms	275.00	275.00	5.00	0.06
BLDG: Dining - Bar lounge/ leisure	Food and Beverage Service - Bars, cocktail lounges	100.00	100.00	7.50	0.18
BLDG: Dining - Cafeteria/ Fast food	Food and Beverage Service - Cafeteria/fast-food	100.00	100.00	7.50	0.18
BLDG: Dining - Family	Food and Beverage Service - Restaurant dining	100.00	100.00	7.50	0.18
BLDG: Dormitory	Hotels, Motels, Resorts, Dormitories - Bedroom/living	250.00	250.00	5.00	0.06
BLDG: Elevators - Equipment	Miscellaneous Spaces - Elevator machine rooms	0.00	0.00	0.00	0.12
BLDG: Exercise center	Sports and Entertainment - Health club/weight rooms	50.00	50.00	20.00	0.06
BLDG: Gymnasium	Sports and Entertainment - Gym, stadium (play area)	50.00	50.00	0.00	0.30
BLDG: Health care - clinic	Health Care (App. E) - Medical Procedure	200.00	200.00	15.00	0.00
BLDG: Hospital	Health Care (App. E) - Medical Procedure	200.00	200.00	15.00	0.00
BLDG: Hotel	Hotels, Motels, Resorts, Dormitories - Bedroom/living	250.00	250.00	5.00	0.06
BLDG: Library	Public Assembly Spaces - Libraries	200.00	200.00	5.00	0.12
BLDG: Manufacturing facility	Educational Facilities - Wood/metal shop	750.00	750.00	10.00	0.18
BLDG: Motel	Hotels, Motels, Resorts, Dormitories - Bedroom/living	250.00	250.00	5.00	0.06
BLDG: Motion picture theater	Public Assembly Spaces - Auditorium seating area	50.00	50.00	5.00	0.06
BLDG: Multi family	Residential - Dwelling unit	250.00	250.00	5.00	0.06
BLDG: Museum	Public Assembly Spaces - Museums/galleries	300.00	300.00	7.50	0.06
BLDG: Office	Office Buildings - Office Space	275.00	275.00	5.00	0.06
BLDG: Parking garage	Unoccupied building zone - e.g. stairs, attic,	0.00	0.00	0.00	0.00
BLDG: Penitentiary	Correctional Facilities - Cell	250.00	250.00	5.00	0.12
BLDG: Performing arts theater	Public Assembly Spaces - Auditorium seating area	50.00	50.00	5.00	0.06
BLDG: Police/ Fire station	Correctional Facilities - Guard Stations	275.00	275.00	5.00	0.06
BLDG: Post office	Office Buildings - Office Space	275.00	275.00	5.00	0.06
BLDG: Religious building	Public Assembly Spaces - Places of religious worship	50.00	50.00	5.00	0.06

Figure 33 - ASHRAE 62.1 Parameters Editor

Air Exchange

Building air exchanges include space ventilation rates & air infiltration ACH.

Outside Air Ventilation Rate (simple)

As an alternative to the ASHRAE 62.1 calculations, users can manually input the fresh air rate for each template. Note that these values will not be used unless the 62.1 calculations are disabled in the LoadCalcsVentilation spreadsheet.

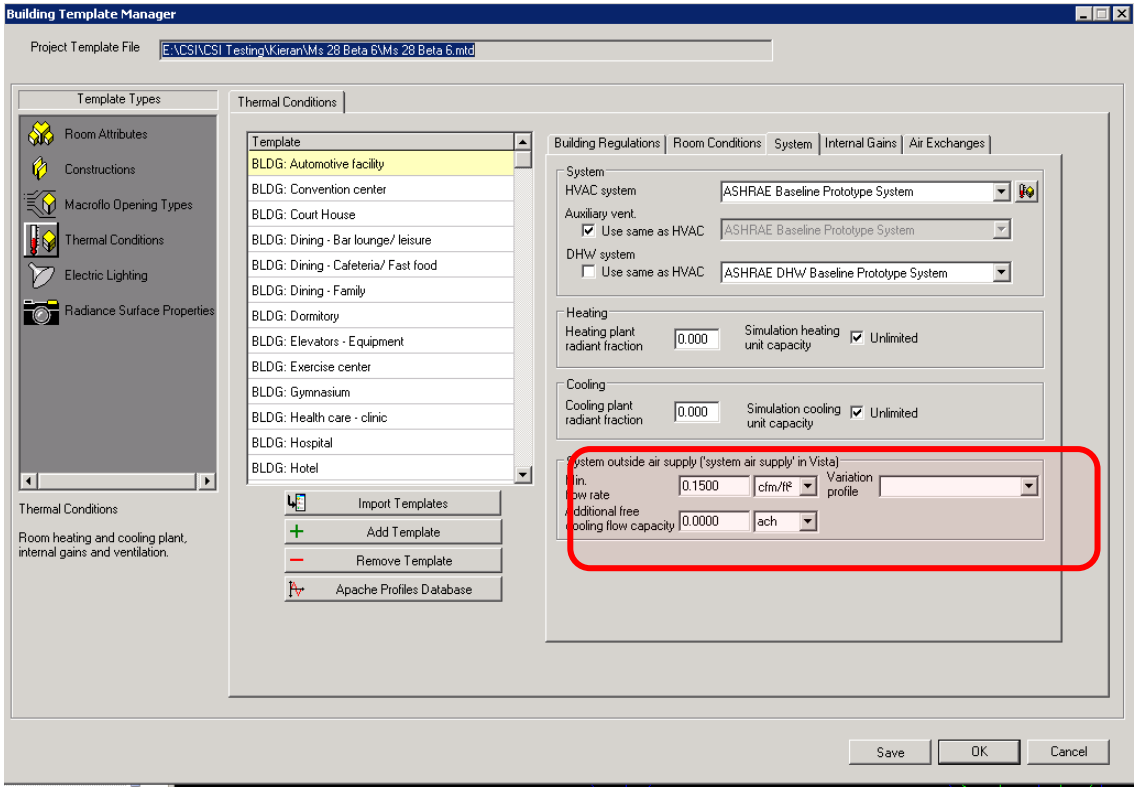


Figure 34 - Building Template Manager - System Outside Air Supply inputs

Infiltration

Specify design air infiltration rate ACH. You must select the row in the table with the red 'T' in the 'Add to Template' column and input the infiltration below in the 'Max Flow' box.

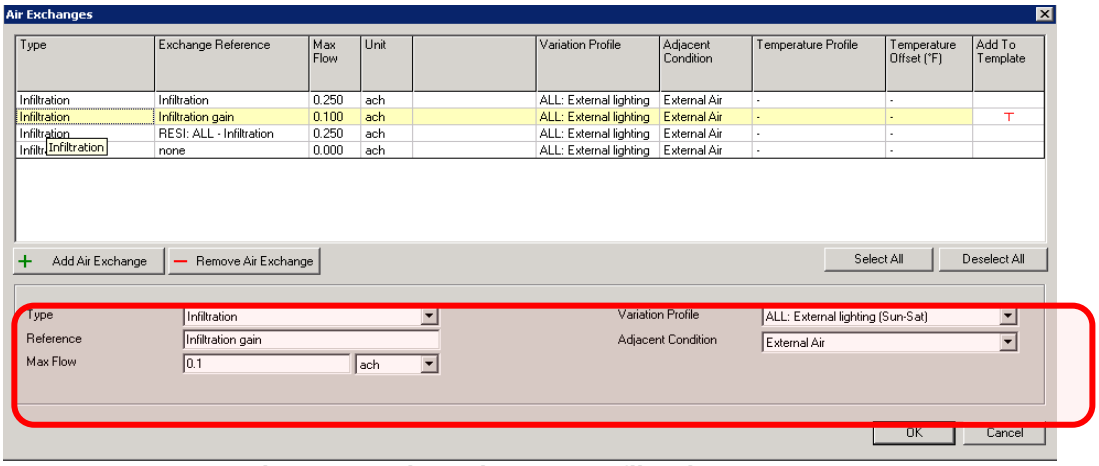


Figure 35 - Air Exchanges - Infiltration Inputs

Other End Uses

Exterior Lighting

The hyperlink takes the user to the 'options' dialog box, which facilitates the calculation of the 'exterior lighting power allowance' (baseline) and the proposed model total. The dialog is constructed based on the requirements of ASHRAE 90.1 section 9.4.5 and is divided into two surface types – 'tradable surfaces' and 'non-tradable surfaces' (similar to Table 9.4.5 within ASHRAE 90.1-2007). The units listed for each end use type are the same as those listed in ASHRAE 90.1-2007.

Baseline Total: To develop the 'exterior lighting power allowance' the user needs to input the appropriate values for the project in the 'Area, Length, etc' column. The value input here will be multiplied by the unit value for that end use to determine the Baseline Subtotal (W). At the bottom of the dialog box under totals the sum of the Baseline Subtotals is reported in the Baseline Total cell.

> *Note: the * note express that the baseline total has an additional 5% added as per the requirements within ASHRAE 90.1, Ch.9, Sec 9.4.5.*
>
> *Note: when entering values in the 'Area, Length, etc' column pay close attention to the units for each end use line item. They vary from per location, to per linear foot to per square foot.*
>
> *Note: when entering values in the cells, double click on the cell to select the overall number in blue, otherwise your entry value will be before the number that is already there. For example if the default value is 0.00 and the user is trying to enter '10',if the user only selects the cell once versus twice and inputs '10', then the value that will appear in the cell is '100'.*

Proposed Total: Once the baseline Subtotals have been determined, the appropriate Proposed Subtotals can be entered in the last column (for each line item). In addition to the 'Proposed Total' being calculated under the 'Totals' area, the 'Tradable Surfaces' and 'Non-Tradable Surfaces' totals for both the Baseline and Proposed are calculated as well to provide another reference point to consider.

Please Note the two notes at the bottom of the dialog box describing where the 'proposed total' value and the 'baseline total' value goes:

- Proposed Total is applied to the internal gain "ALL:Exterior Lighting" and is assigned to the last room in the proposed model.
- Baseline Total is applied to the internal gain"ALL:Baseline Exterior Lighting" and is assigned to the last room in the baseline model.

Exterior lighting is controlled using a default formula profile that simulates a photo cell switch. See ASHRAE 90.1 Section 9 for further exterior light details.

The highlighted portions of the figure below show which columns the user would input values within, and the location where the totals are reported.

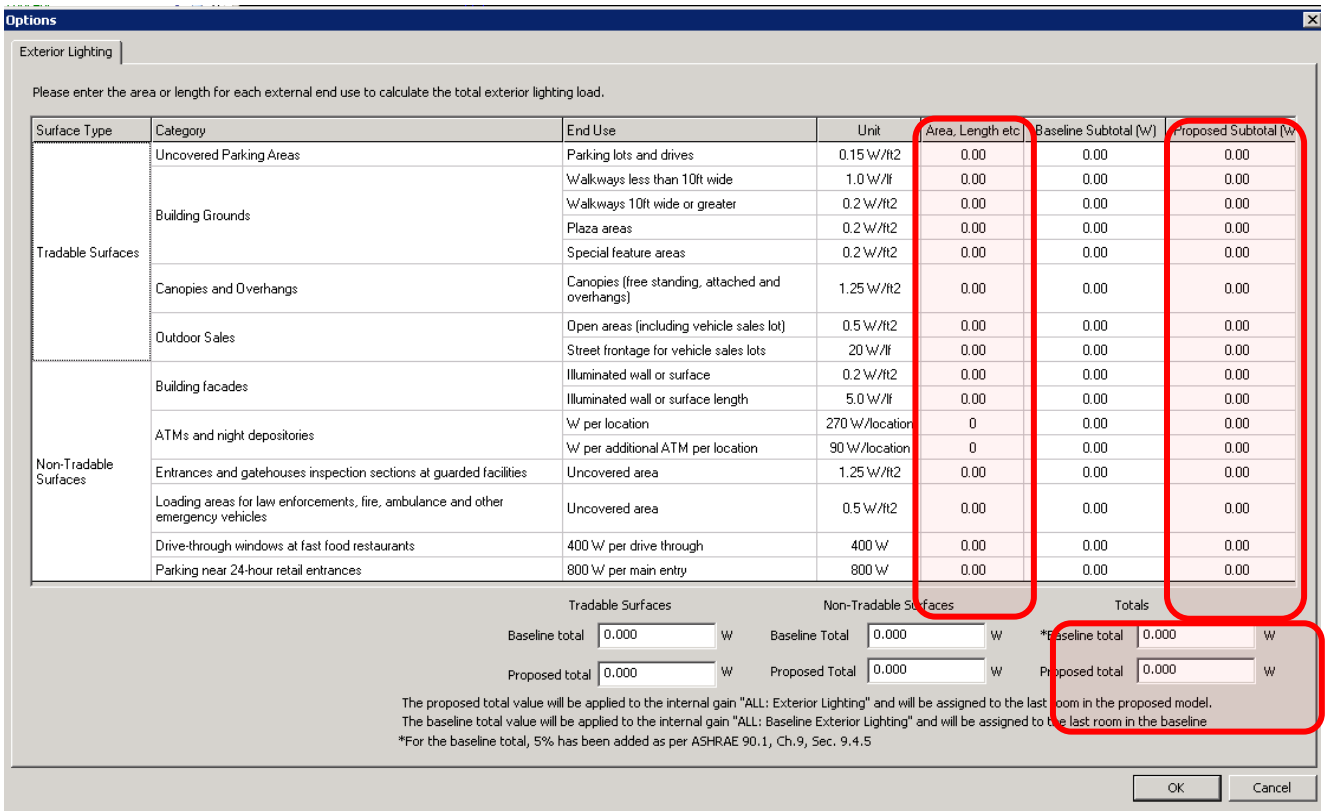


Figure 36 - Options - Exterior Lighting - Baseline and Proposed Inputs and Calculations

Exterior lighting rules

Entering data…

For each line, if Baseline > 0, then Proposed must also be > 0 (i.e. can't take credit for unlit surfaces). If Baseline >0 and Proposed = 0, then pop-up a warning message. (applies to both tradable & non-tradable). Likewise, if Proposed >0 and Baseline=0, user will receive a warning message

For each line of tradable surfaces, it is permissible for Baseline > Proposed, or Proposed > Baseline (as long as they are both non-zero values)

For each line of non-tradable surfaces, it is permissible for Proposed>Baseline. However, if Proposed entry < Baseline, then Baseline value is adjusted to be equal to Proposed entry.

Calculating subtotals…

For tradable surfaces, it is permissible for Baseline > Proposed, or Proposed > Baseline (as long as they are both non-zero values)

For non-tradable surfaces, it is permissible for Proposed>Baseline. However, baseline cannot be greater than proposed, (this should not occur if rules above are followed)

Calculating grand total…
Baseline grand total = 1.05 *(baseline tradable + baseline non-tradable)
Note: (5% has been added to the total as per ASHRAE 90.1, Ch.9, Sec. 9.4.5)
Proposed grand total = proposed tradable + proposed non-tradable
If Proposed grand total > Baseline grand total, then proposed exterior lighting design is non-compliant.

Elevators

Elevator end usage energy can be assigned to the baseline & proposed model in one of two ways, using a peak demand approach or based on an annual kWh rating. The number of lifts must be entered in the dialogue box provided, and should be the same for both baseline and proposed models. The default ASHRAE 90.1 user guide elevator profiles may be used to control this output by selecting the elevator profile for your appropriate building type. In order for the elevator energy to be assigned to the model there must be at least one zone assigned to the elevator grouping scheme.

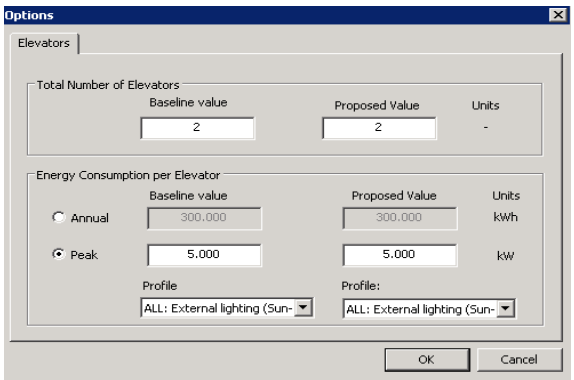


Figure 37 - Options - Elevators Inputs Dialog Box

Service Hot Water

Each thermal template must be assigned a hot water consumption quantity in (l/h max) as per the proposed design. The hot water consumption is directly linked to default ASHRAE 90.1 user guide services hot water profiles, however hot water consumption can also be linked to template “occupancy profiles” by selecting the “link to space occupancy profile” from the “Consumption Pattern” drop down box. DHW plant setup is performed during the baseline HVAC system setup. The assignment of SHW demand can also be approached by assigning a single SHW demand to a single room with a standalone profile this needs to be done via the query button & pre-baseline generation.

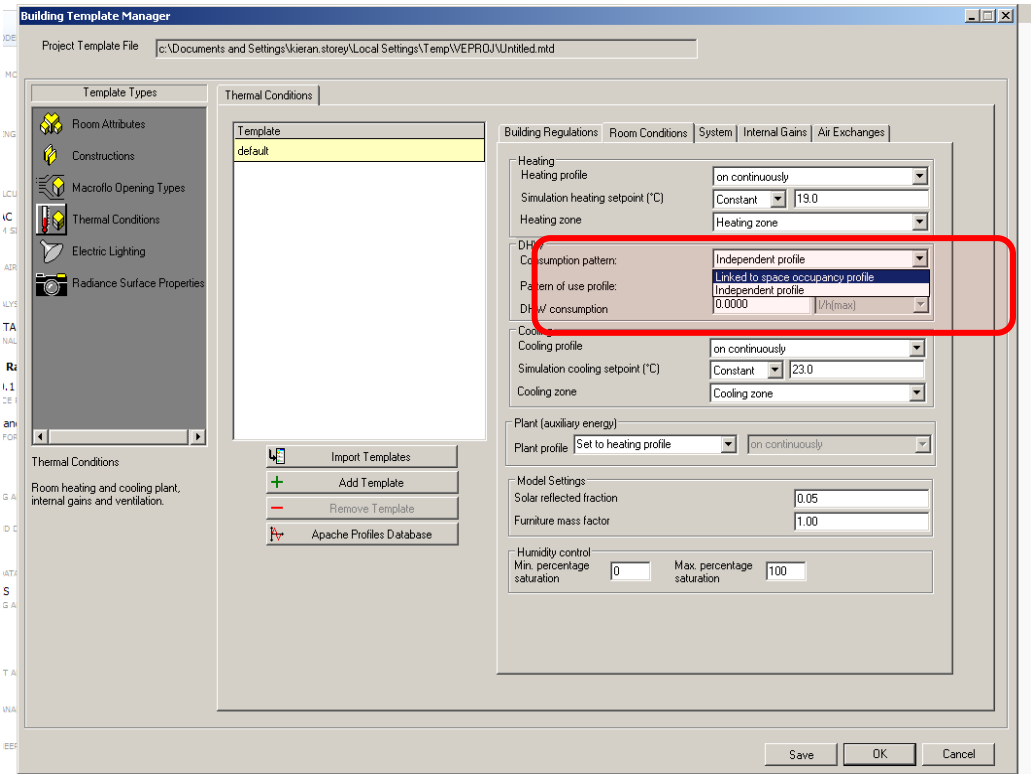


Figure 38 - Building Template Manager Hot Water Consumption input

8. HVAC Systems

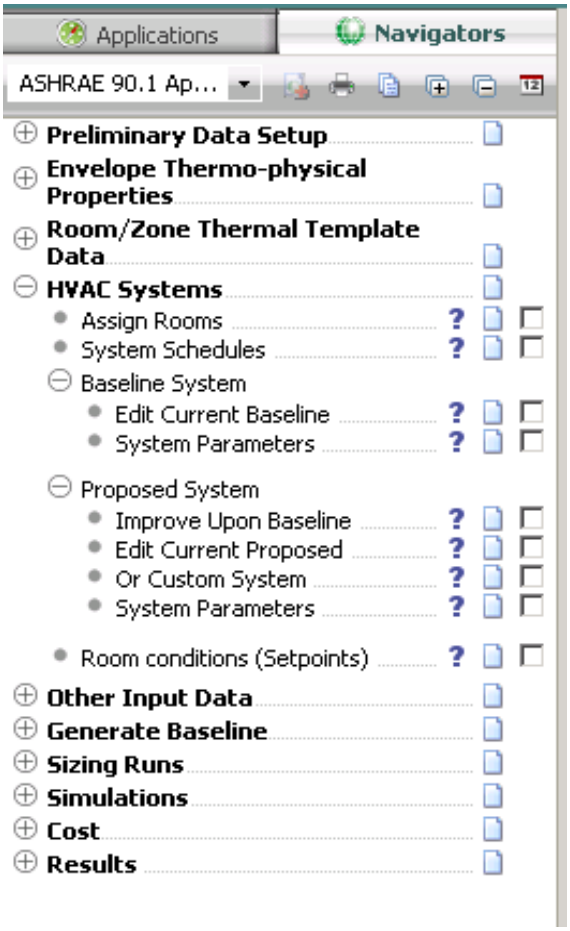


Figure 39 - HVAC Systems Sub-categories and Tasks

This navigator category consists of a number of sub-categories and tasks designed to guide users through the process of setting up the baseline & proposed HVAC systems.

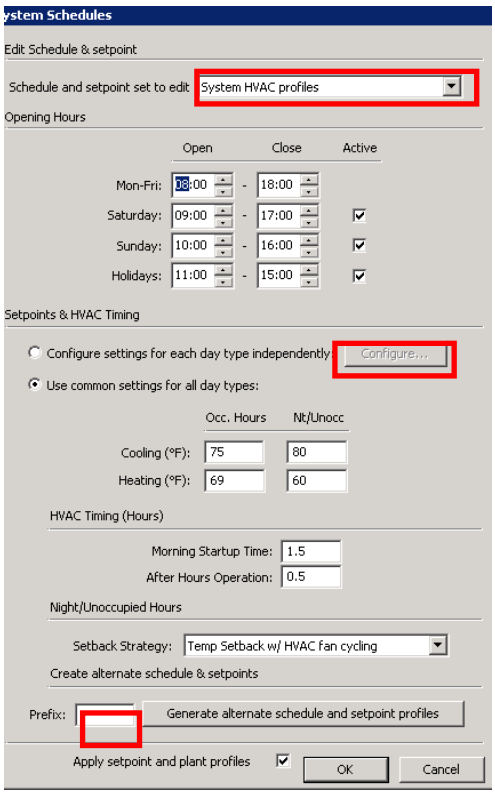
Set up Room Grouping for HVAC Assignment

Once a predefined system or systems has been loaded or a custom system created in ApacheHVAC, all conditioned rooms, HVAC zones, supply plenums (if any), and return plenums (if any) must be assigned to the HVAC network. If not, they will be conditioned instead by a simplified method in Apache Systems—within the Apache Thermal view. While Apache Systems is appropriate for early schematic design and for compliance with certain standards, more detailed ApacheHVAC systems should be used for comparative analysis of design and control strategies, supporting design decisions, and documenting projected energy performance and must be used for the ASHRAE 90.1 Performance Rating Method. If there are unconditioned spaces in the building, they should have the HVAC System selection on the *System* tab in the associated room thermal template or *Room Data* set to “None”. As such, if they are not assigned to an ApacheHVAC system, they will not be conditioned.

While rooms or zones can be individually added to new layers in the multiplexed HVAC network, for all but very small projects with few rooms it is far more efficient to assign the rooms/zones from room groups. To do so, click once anywhere in the multiplexed region dashed green line) to select it and then click the *Edit Multiplex* button. The *Assign from room group* button allows entire groups of rooms to be assigned to the selected ApacheHVAC network. This will automatically add more layers as needed; however, if subsequently assigning rooms from additional groups, be aware that the last layer on the list of Layer and Principle Rooms must first be selected and this layer will be assigned to the first room/zone in the group.
All rooms or zones should be organized in groups using an appropriate grouping scheme, such as one group per air handler or similar, prior to assigning rooms in ApacheHVAC.

System Schedules

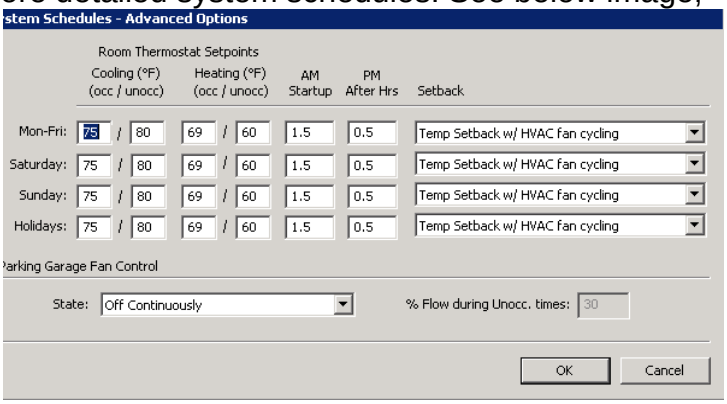
Set ApHVAC system operation schedules. Indicate the occupied and unoccupied hours and the associated heating and cooling set points. The morning start-up and after-hours operation are in relation to the occupied hours. Select the appropriate control strategy for operation using setback temperatures during the unoccupied hours. These settings will apply to all ApacheHVAC systems for this project that use the default control (HVAC HP1, HP2, CP3, CP6, etc.) profiles referenced in the prototype baseline system controllers. These inputs are important for the unmet load hour check as they essentially set the heating & cooling system schedules/set point temperatures



Any number of additional HVAC schedules can be created to match any building system operation schedule or set point where zones may have different requirements. This is done by entering a “Prefix” refer in the dialogue & clicking the “generate alternative schedule & set points”. For example if a prefix refer of “0823” is entered & generate is clicked a copy of the default HVAC control profiles will be created in ApPdbm with prefix of “0823” at the start of all control profiles.

Alternative profiles can be selected for global assignment via the “schedule & set point” dropdown at the top of the schedule dialogue, the “Apply set point & plant profiles” tick box must be activated for assignment to happen once the OK is clicked in the main dialogue. If a model uses varying operation schedules these profiles must be assigned manually to ApHVAC systems in later workflows.

Advanced schedules can also be setup via the “Configure” tab in the main dialogue this feature allows users to setup more detailed system schedules. See below image;

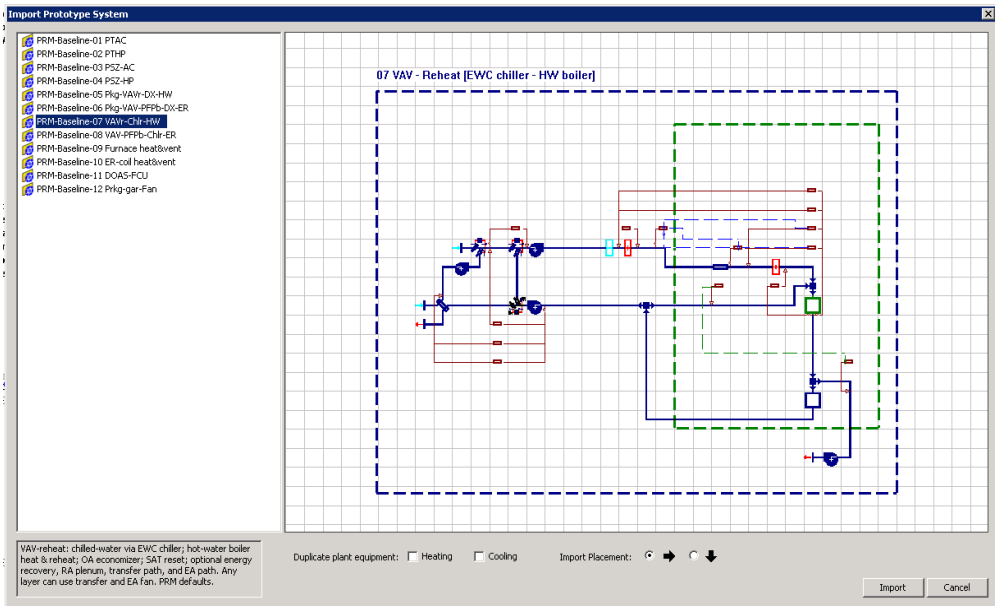


Baseline system

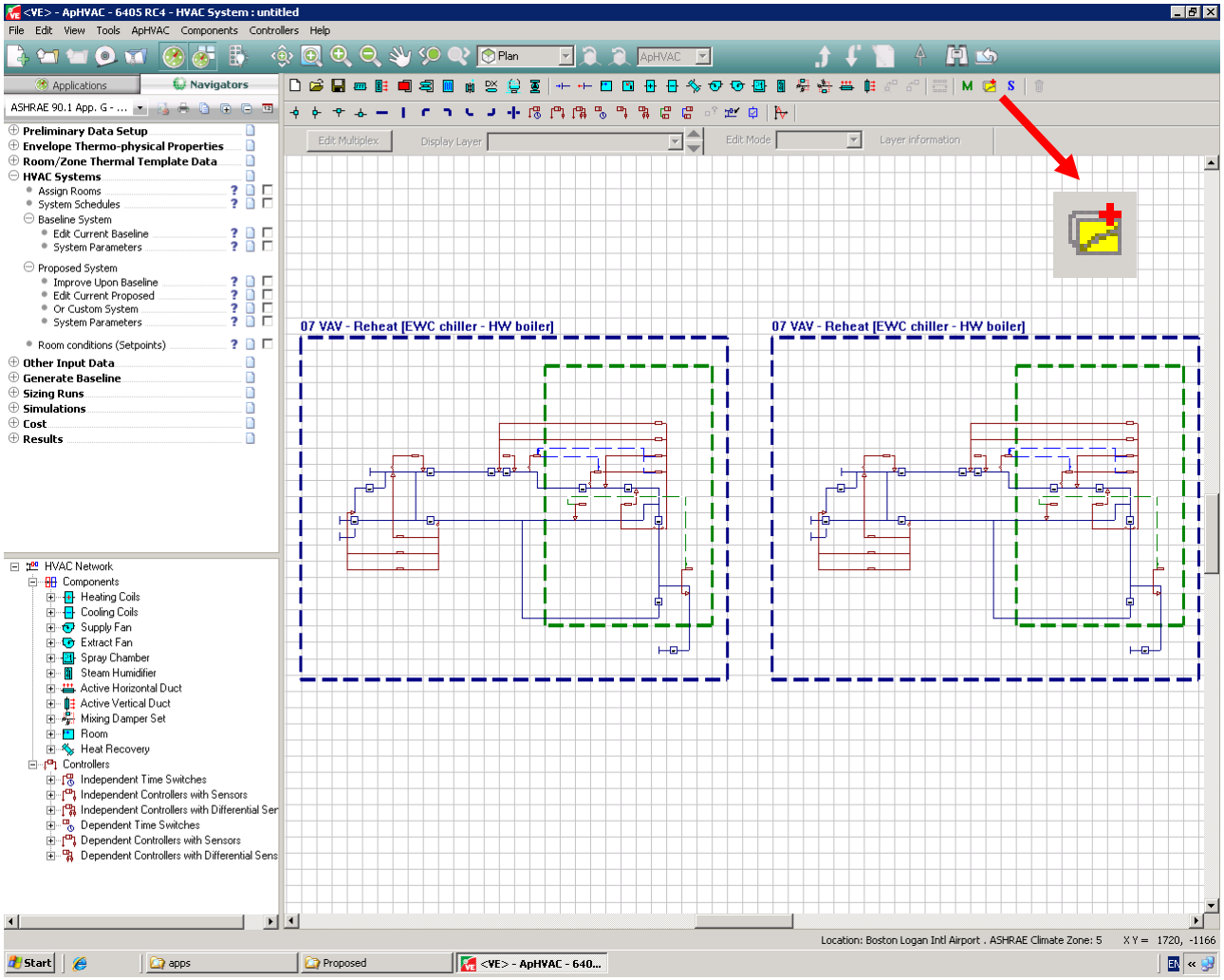
Setup Baseline system configuration for system sizing runs

Edit Current Baseline

Users are presented with the ten ASHRAE 90.1 baseline HVAC systems, which correspond to System 1-8(10) listed within Table G3.1.1A and Table G3.1.1B (2007 & 2010). Users must identify which baseline system is required to be modeled for the project in question based on the ‘building type’ (type and area) and whether the energy source is a combined approach (fossil fuel, electric, hybrid, etc) or ‘electric or other’, which are outlined in the tables mentioned above. Once the system type is identified users select & import the system(s) on to the ApHVAC work space. A number of system loops will need to be imported depending on the system design in question. Prototype systems can be imported in a vertical or horizontal placement. The auto placement automatically arranges HVAC systems in a tidy fashion on the work space.

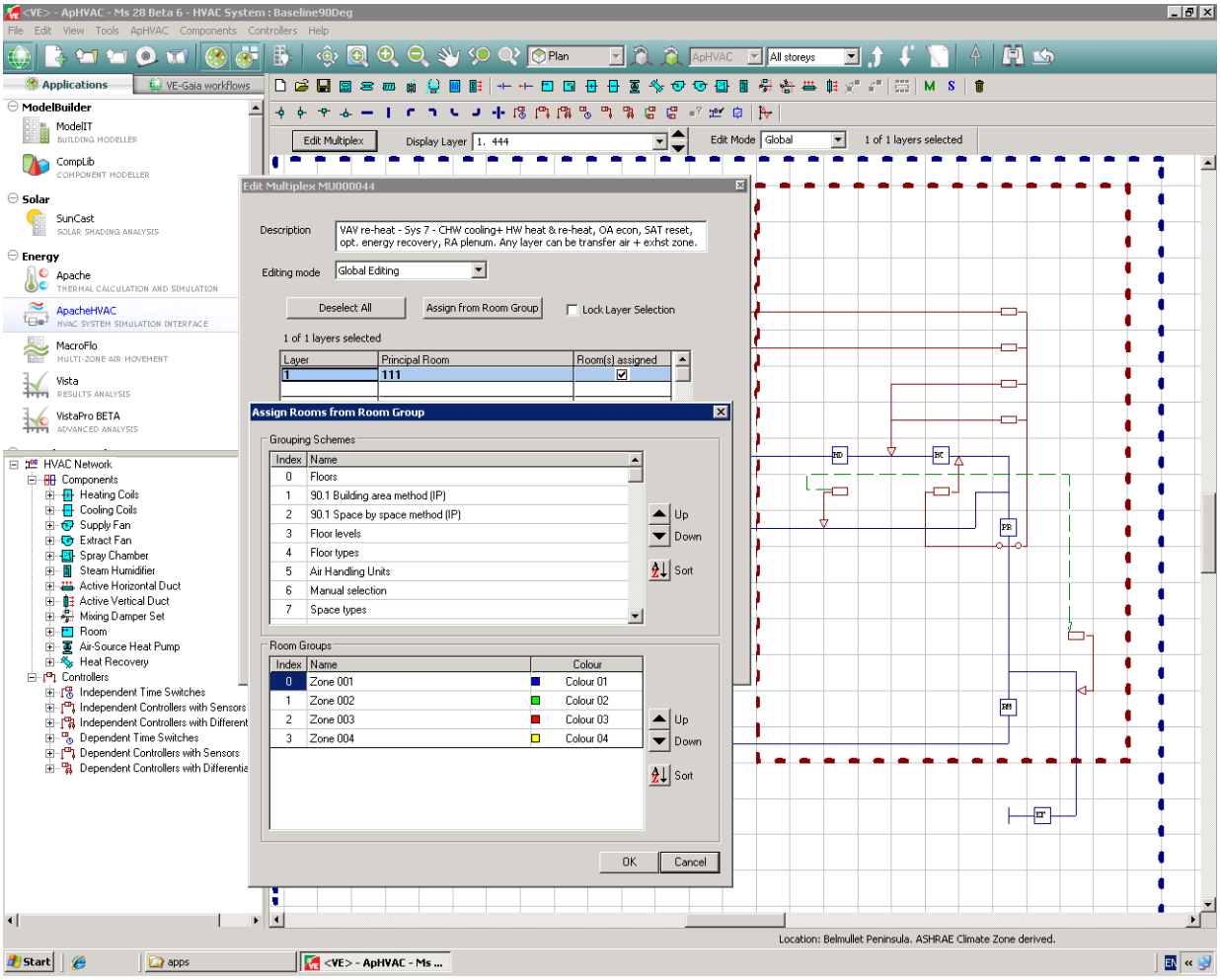


The above image is the “Import prototype system” dialogue. This dialogue can be re-activated by clicking the “Import prototype type system” button in the main ApHVAC tool bar. If I re-activate this dialogue multiple system loops can be imported in the ApHVAC work space, see below image with two system 7 loops imported;



Once the systems have been layout in the required configuration on the ApHVAC work space baseline HVAC networks should be renamed & organized accordingly. Selecting the “S” icon & double clicking any ApHVAC baseline network will allow users rename HVAC networks.

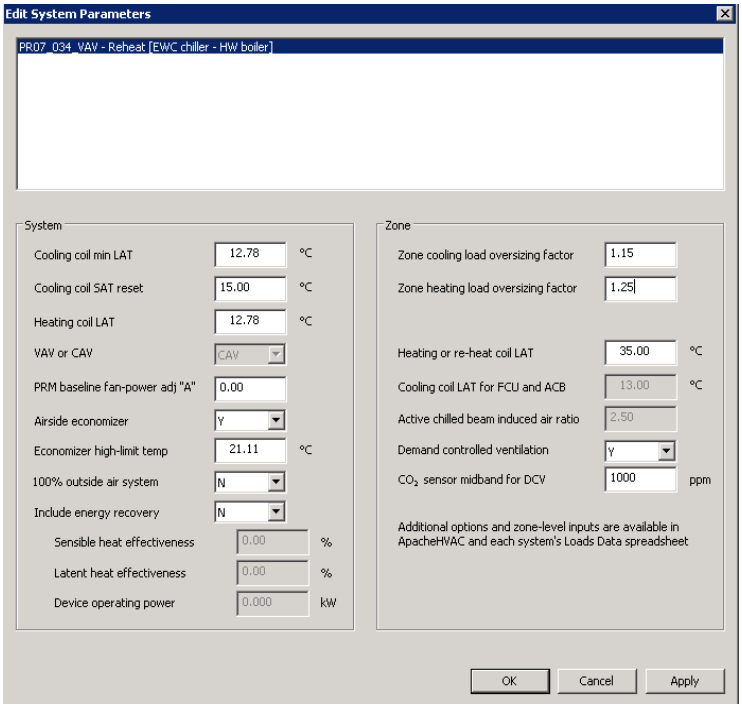
HVAC grouping scheme must be assigned to the ApHVAC networks these grouping schemes should have been created in the “Assign rooms” workflow action. Double clicking the Multiplex & using the “Assign from room group” icon allows groups of rooms to be assigned to the selected ApHVAC network.



See ApHVAC user guide for further information on Multiplexing & the group assignment feature.

System Parameters

Select the HVAC network(s) from within the white dialogue box & set the below system information, click “Apply” & “OK”. This information is critical to the baseline sizing runs. Energy recovery & air side economizer rules must be manually applied using the system parameters dialogue as per the ASHRAE 90.1 section 6 & Appendix G. Certain inputs will be grayed out where inputs are not applicable to the selected prototype system in question.



Varying system information can be assigned to individual & multiple system types, once the information is set OK can be clicked & all information will be applied accordingly.

Proposed System

Users have the option to create the proposed HVAC network by copying and editing the existing baseline HVAC network or by creating a new HVAC network from scratch or using one of the prototype systems.

Improve Upon Baseline

Users are presented with the option to use the Baseline system as the proposed system. Edits can be made to the baseline system & then saved as the proposed system. This is a useful feature for early stage PRM modelling.

Clicking this link in the navigator is the same as clicking “save as” while having the baseline network open and saving it as “proposed.asp”.

Edit Current Proposed

Edits can be made to the copied baseline HVAC system & saved as the proposed system. For early stage analysis where the system may not be know this is a useful option for assessing the affects of introduction generic system optimization strategies for example;

- Energy recovery
- Air side economizer
- Water side economizer

- High efficiency plant
- VSD pumps
- High efficiency fans
- Etc

OR Custom System

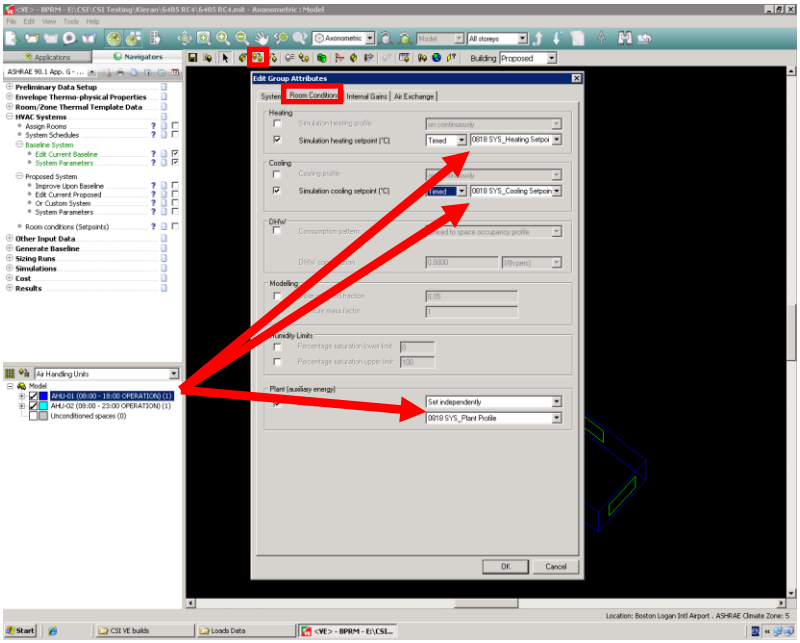
Opens a new blank HVAC work space so that users can create a proposed HVAC network from scratch or select one of the pre-defined prototype systems. All prototype systems can be auto sized & customized to match the proposed HVAC system design. Auto sizing the proposed system will only be applicable for early stage analysis as the proposed system must represent the actual system design in order to accurately assess the quality of the HVAC design. Modifying the proposed network to represent the actual system design would involve creating the actual plant components as per there type & capacity, inputting actual design air side flow rates & setting up all auxiliary system components as per there design (fans & pumps etc).

AHU System Parameters

As per baseline “AHU system parameters” assignment

Room conditions (Set points)

Set design heating and cooling set point temperatures for ASHRAE load calculation, HVAC system sizing purposes & unmet load hours check. This involves using the “edit group attributes to manually assign the corresponding “Room conditions” & “Plant profile” to the relevant ApHVAC grouping scheme. For example a simple two zone model has been created with a standalone HVAC system for each room. Each room has an alternative set of HVAC operation profiles which have been created previously at the “system schedule” stage.



The above image shows the manual assignment of the “0818” operation profiles to the “AHU-01(08:00 – 18:00 OPERATION)” HVAC grouping scheme. This process should be repeated for all HVAC groups with alternative HVAC operating schedules.

Note: This step is critical to the “Unmet load hours” check to operate correctly.

9. Other Input Data

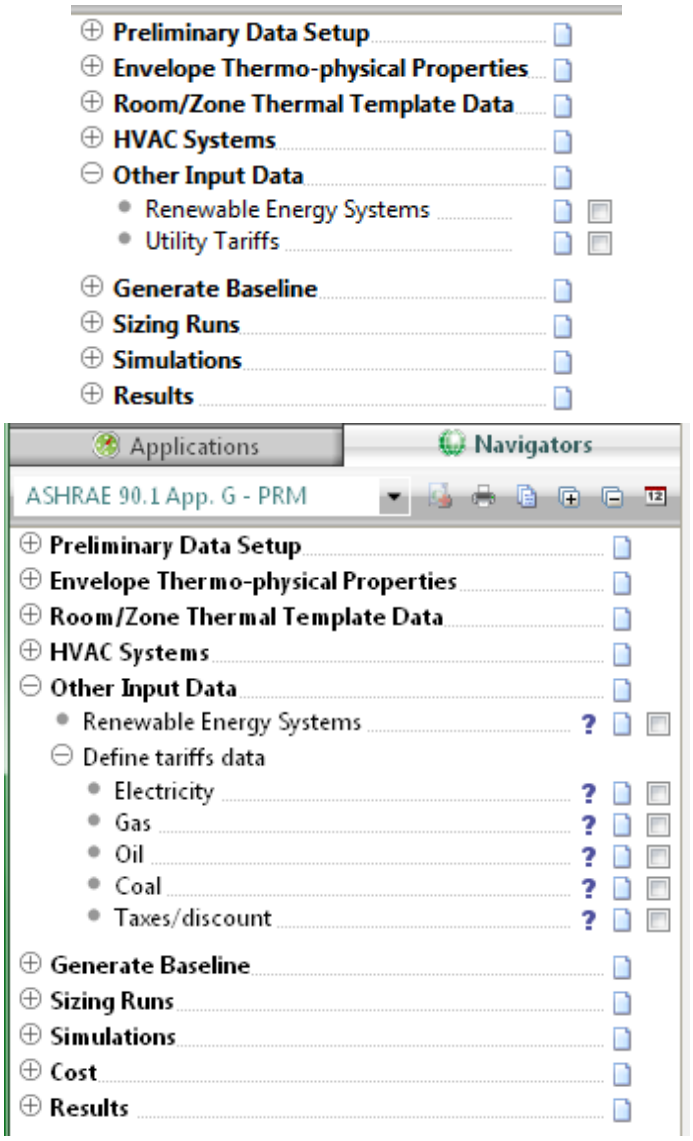
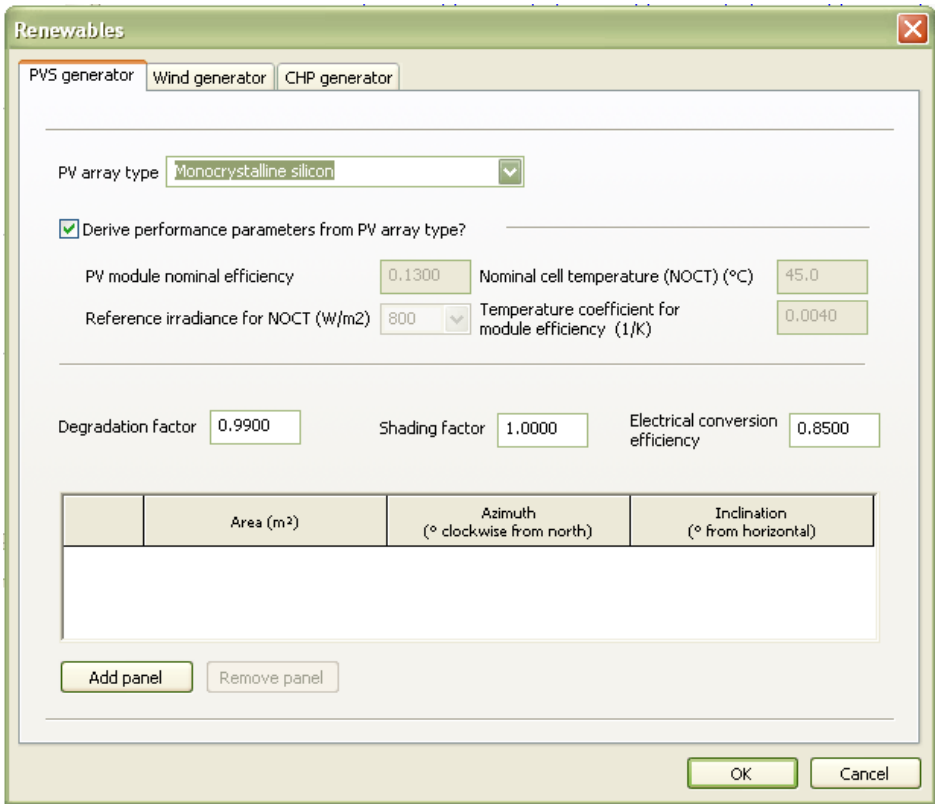


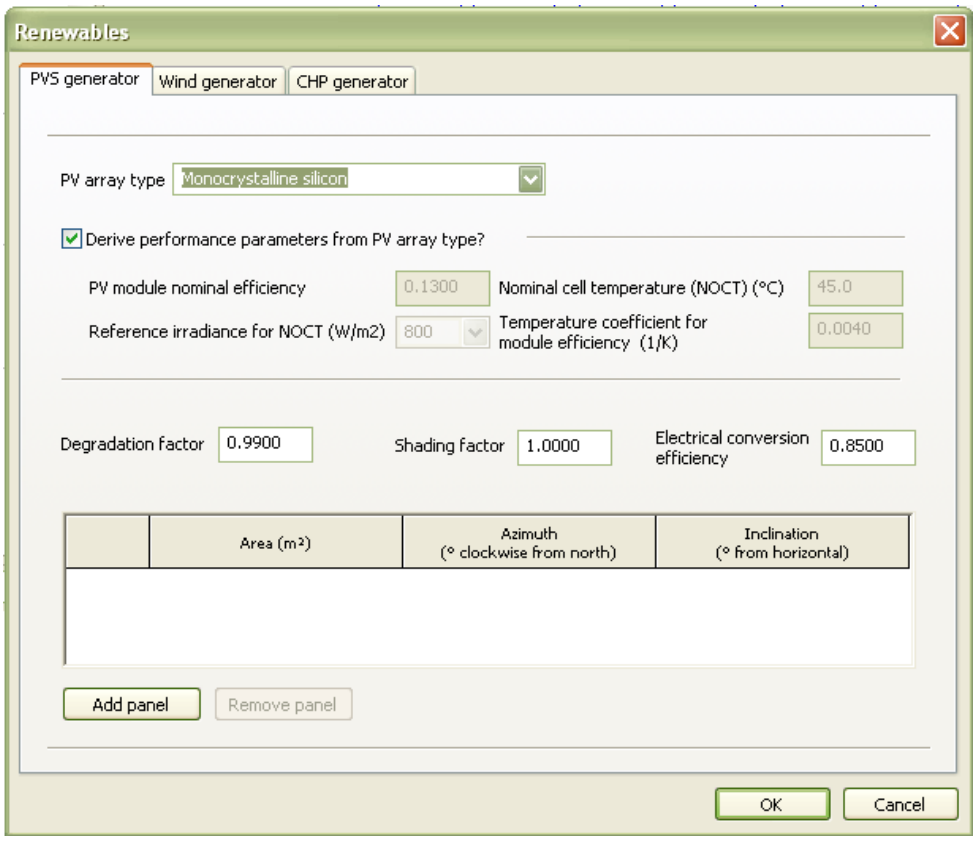
Figure 40 - Other Input Data - Tasks

Renewable Energy Systems

There are three types of renewable systems available:

- PVS Generator
- Wind Power
- CHP Generator
- See Apache Sim User Guide for more information on renewables.


Renewables
PVS generator
Wind generator
CHP generator
PV array type
Monocrystalline silicon
Derive performance parameters from PV array type?
PV module nominal efficiency
0.1300
Nominal cell temperature (NOCT) (°C)
45.0
Reference irradiance for NOCT (W/m2)
800
Temperature coefficient for module efficiency (1/K)
0.0040
Degradation factor
0.9900
Shading factor
1.0000
Electrical conversion efficiency
0.8500
Area (m²)
Azimuth (° clockwise from north)
Inclination (° from horizontal)
Add panel
Remove panel
OK
Cancel


Renewables
PVS generator
Wind generator
CHP generator
PV array type
Monocrystalline silicon
Derive performance parameters from PV array type?
PV module nominal efficiency
0.1300
Nominal cell temperature (NOCT) (°C)
45.0
Reference irradiance for NOCT (W/m2)
800
Temperature coefficient for module efficiency (1/K)
0.0040
Degradation factor
0.9900
Shading factor
1.0000
Electrical conversion efficiency
0.8500
Area (m²)
Azimuth (° clockwise from north)
Inclination (° from horizontal)
Add panel
Remove panel
OK
Cancel

Utility Tariffs

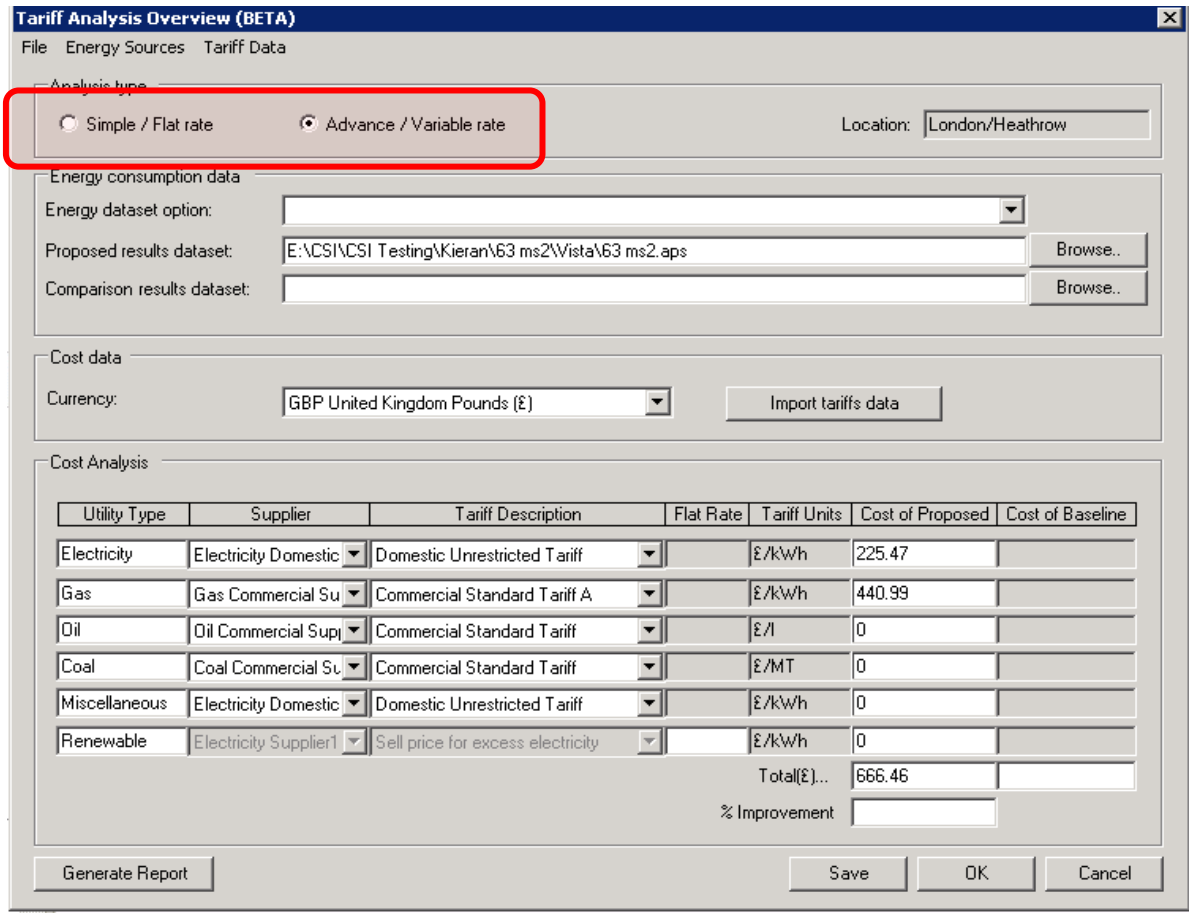
Introduction

Tariff Analysis tool is used to convert the results in energy units from ApacheSim into results in monetary units. The tool allows the user to create real tariffs, which can be saved and shared with other projects, to perform a cost analysis study and easily visualize the improvements from selecting different tariffs.

PRM is based on a comparison of total cost of the proposed and baseline buildings:
PRM documentation: ASHRAE 90.1 Appendix G2.4 Energy Rates: Annual energy cost shall be determined using either actual rates for purchased energy or state average energy prices. Tariff Analysis tool would allow the user to create advance tariffs that replicate the actual rates or to create simple tariffs to input the state average energy price.

Overview

This is the main window of the tariff Analysis. From this window users can select the tariffs selected, import the aps file from Vista and run the analysis. This window will also display the final cost for each utility for the tariff that has been analysed.



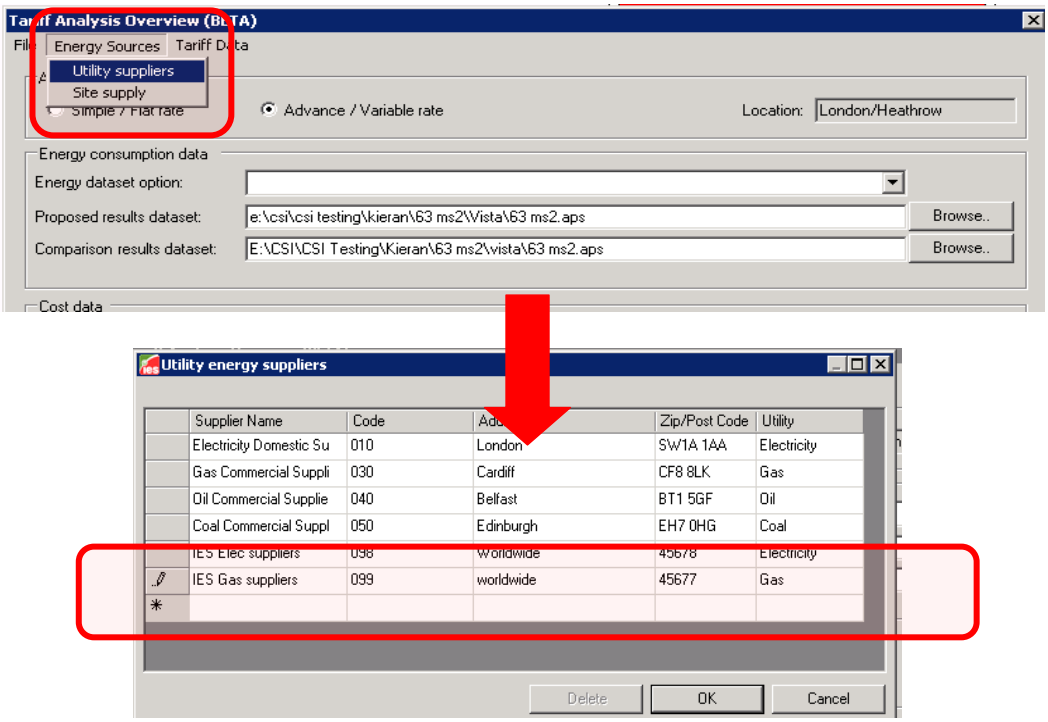
Users are presented with two tariff options;

1. Simple/flat rate

2. Advanced/variable rate

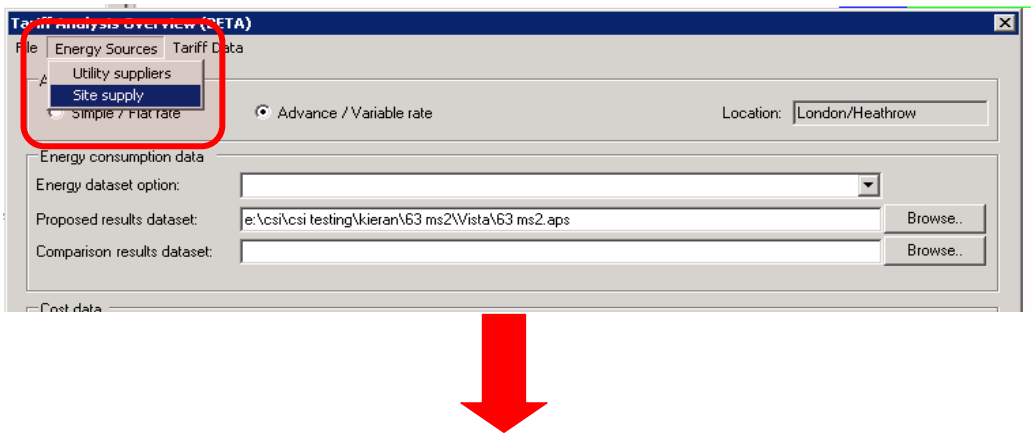
Creating an "Advance/variable rate" Custom Tariff

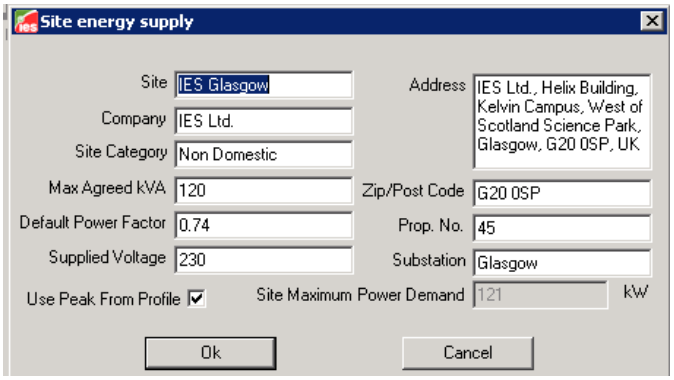
1. In the main tool bar select the "Energy source" tab & select "Utility Supplier", users can add custom Utility supplier information for all Utilities.



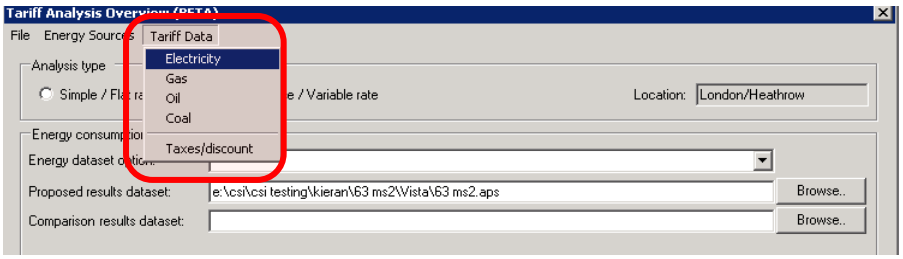
Click the * in the left dialogue allows custom utility energy suppliers to be added to the project.

2. The site energy supply information must then complete, this can be found in the "Energy source" tab in the main tariff tool bar.

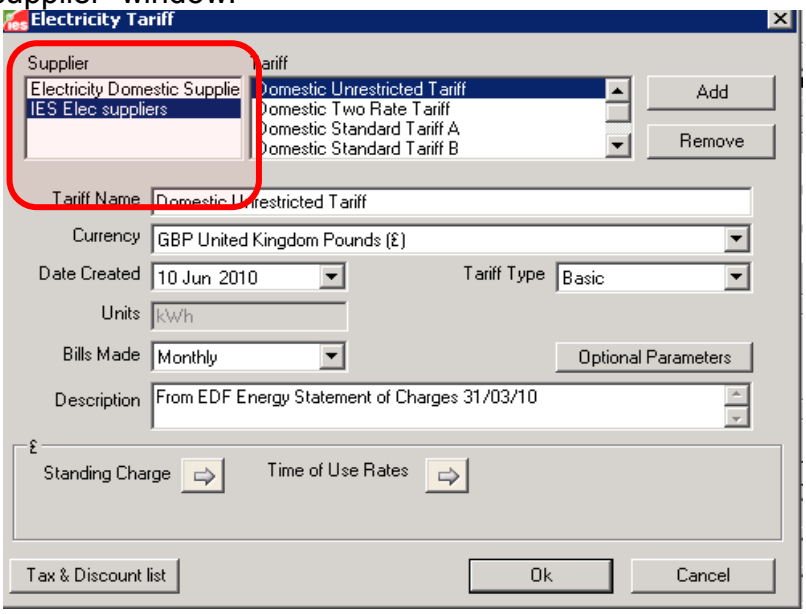




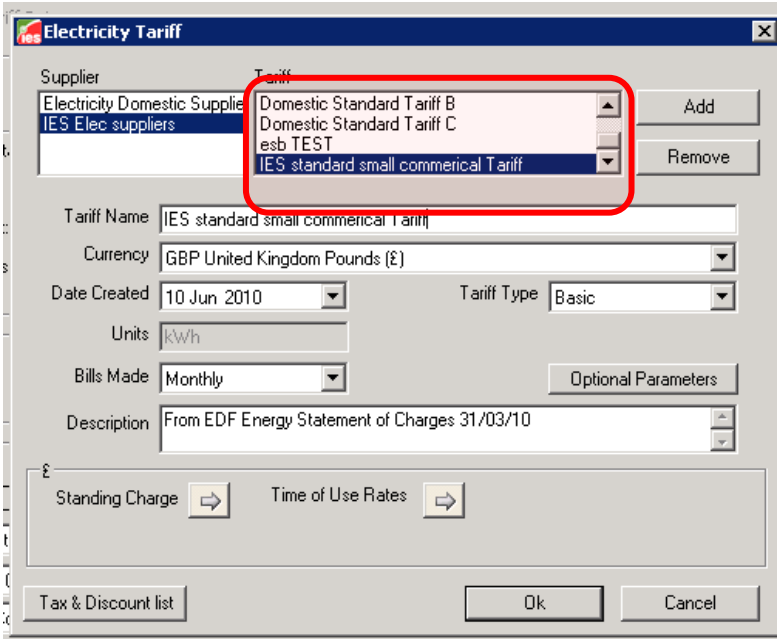
3. Tariff data must now be created for all required utilities, clicking the “Tariff data” tab in the main tool bar will allow users created the required tariffs.



Users will be presented with a listed of suppliers as per step 1. Tariffs can be added & remove to the supplier tariff template. The below dialogue shows the created utility company in the “supplier” window.

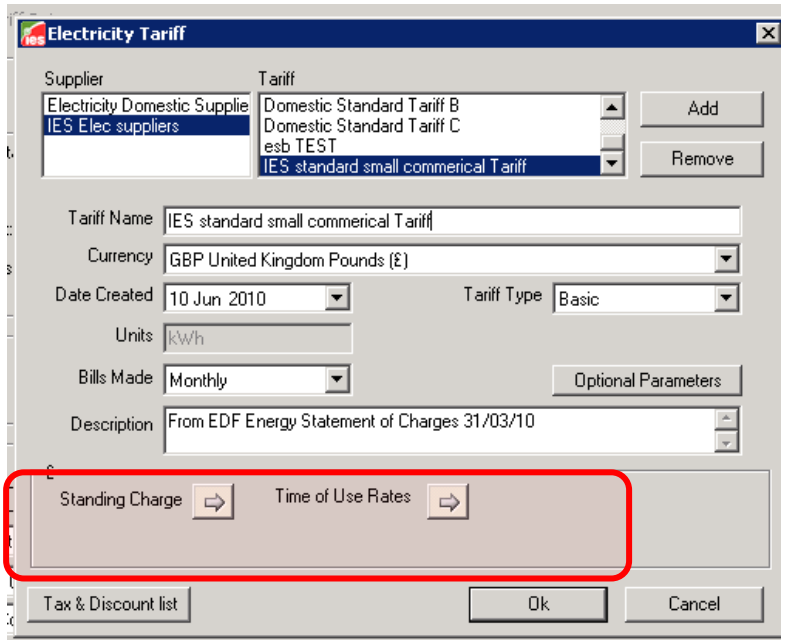


Tariffs can be added to the supplier template by clicking “Add” & naming the tariff. Once the tariff has been added the following information must be set:

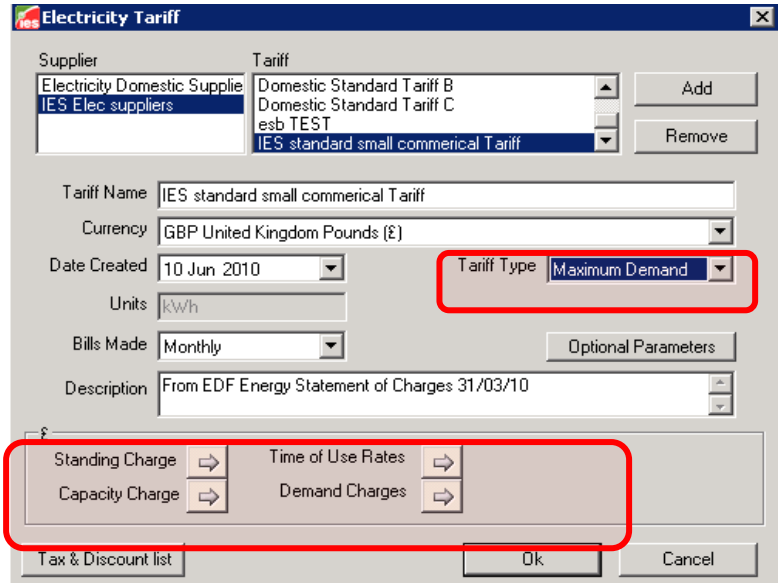


- Currency
- Dated created & Tariff type
- Bills Made

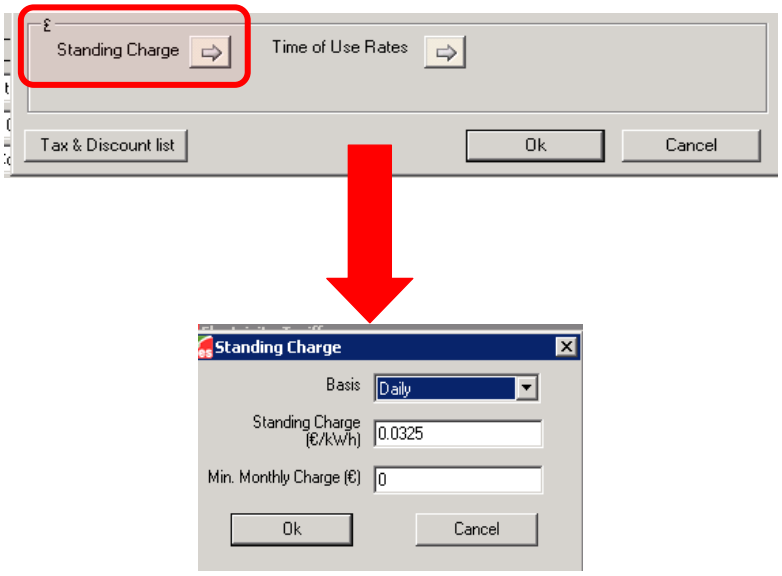
4. Once the above information has been set the detailed “Tariff type” information must be set. Depending on the tariff type selected more icons will become available for example; when the “Basic” tariff type is selected two icons appear “standing rate & time of use rates.



Or with “Maximum Demand” tariff type

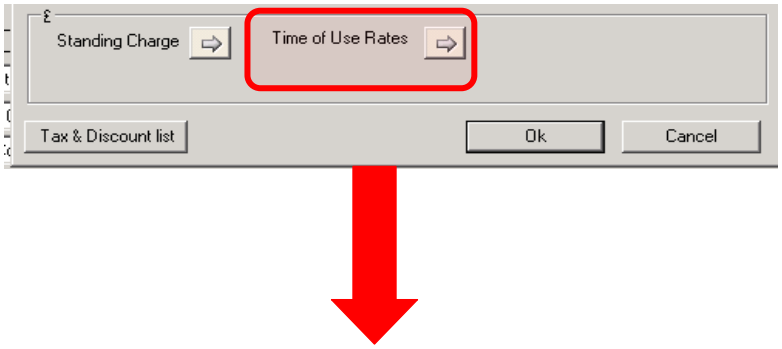


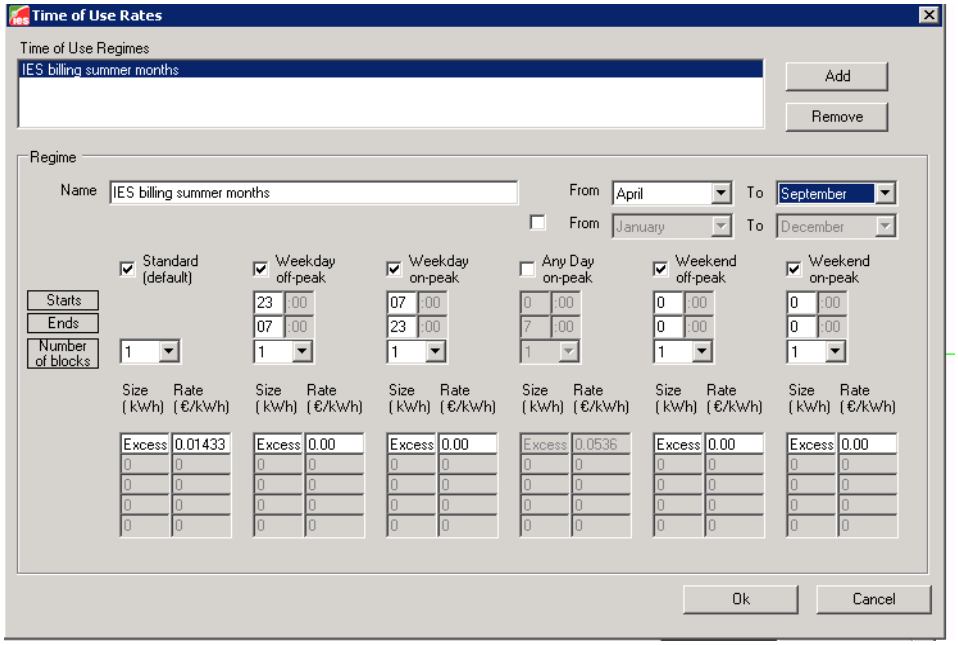
5. Setting charges



Set basic, standing & Min. Monthly charge as indicated above.

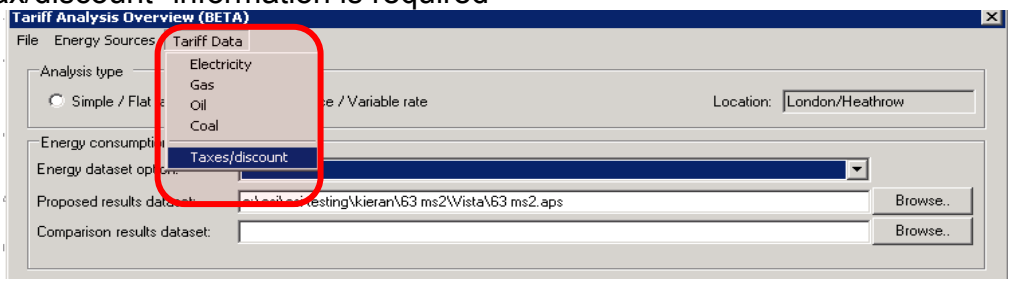
6. Set time of use regimes, detailed variable tariff information can be set here.

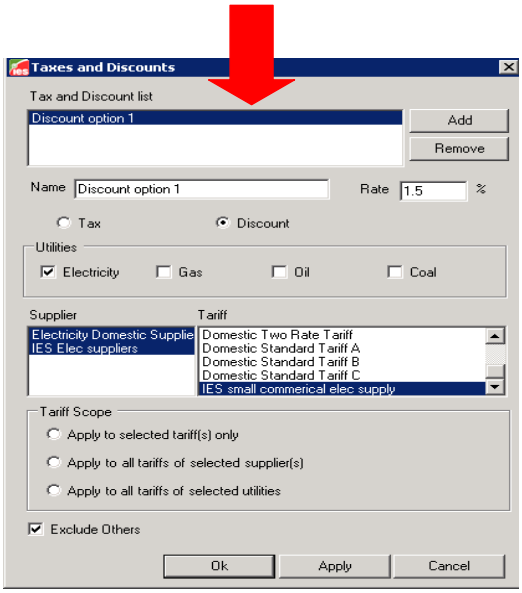




MORE DETAIL NEEDED!!

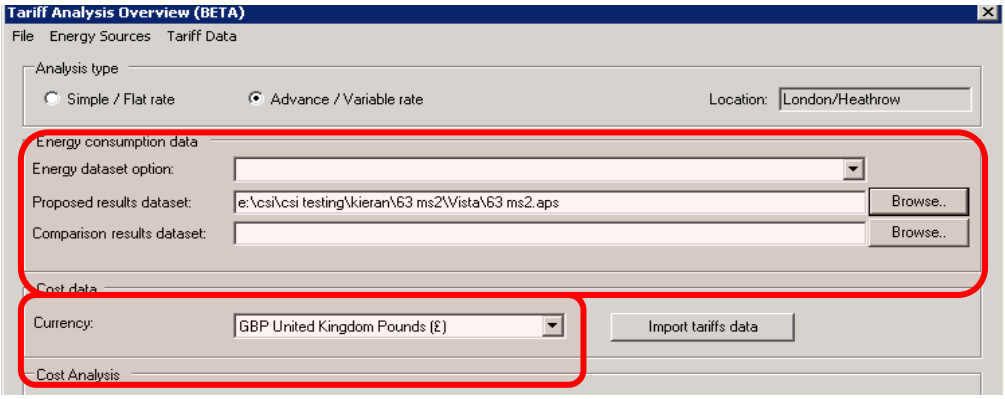
7. Set “Tax/discount” information is required



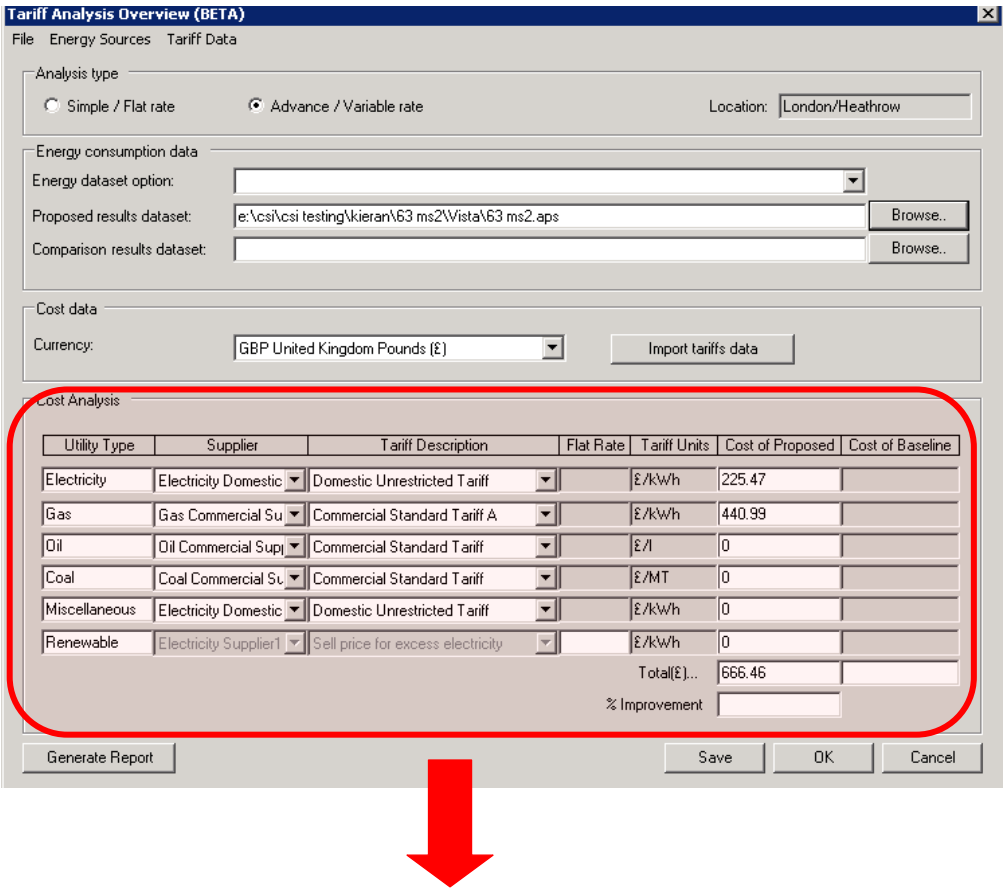


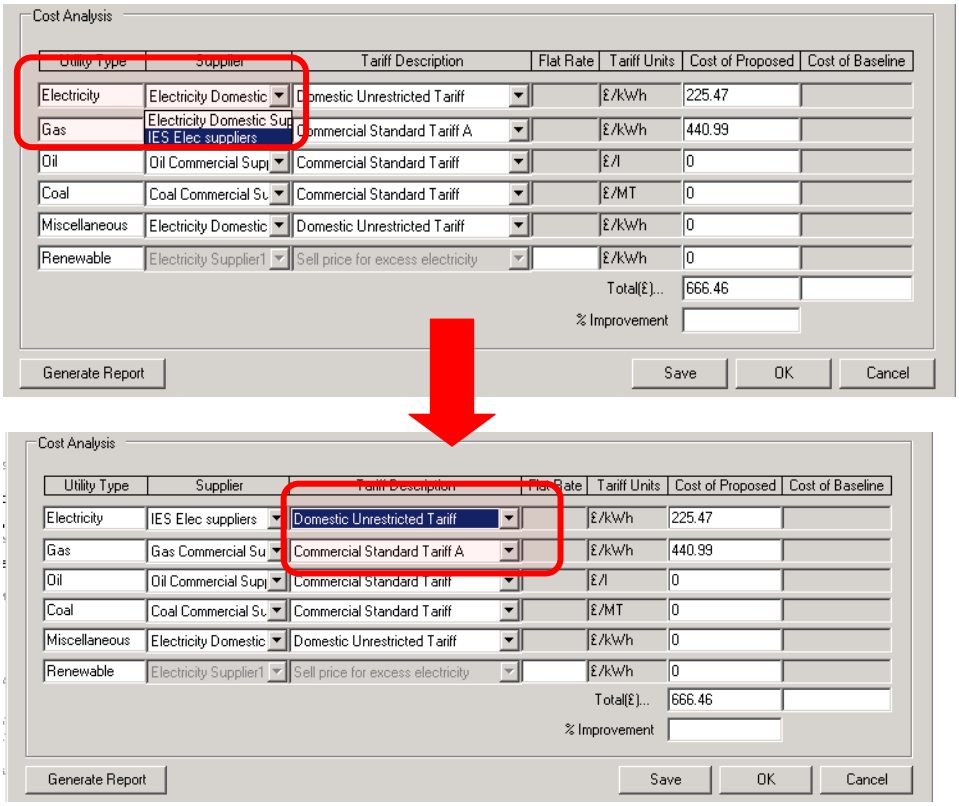
8. Once the previous steps have been followed the custom tariff data can now be assigned to the utility types.

- First set the “Energy consumption data” users must select the required vista results aps. Files to be used for the cost analysis.



- Also set currency type (see above)
- Set “Cost Analysis” information (assign custom tariff templates as previously created)





The resulting Cost output will now reflect the custom created tariff data.

Creating a "Simple/Flat rate" Tariff

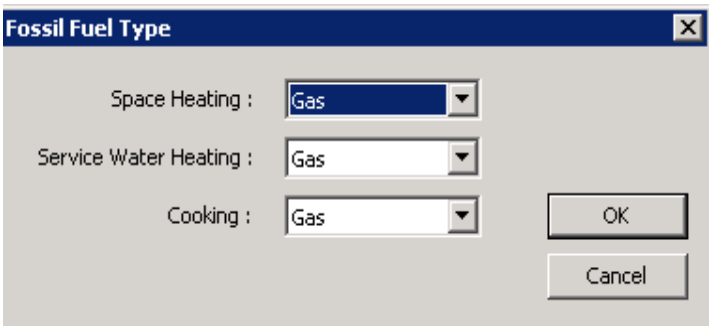
For further detail on using the tariff analysis tool please refer to the "Tariff analysis user guide".

Fossil Fuel Type

All miscellaneous fuel codes are assumed to be electricity except for:

- Space Heating
- Service Water Heating
- Cooking

These end-uses may be either electricity or fossil fuels, and there are two options for fuel code assignment. If the fossil fuel option is chosen, this window allows you to change the fuel type for these fuel codes for the sake of calculating fuel consumption and energy cost.



10. Generate Baseline

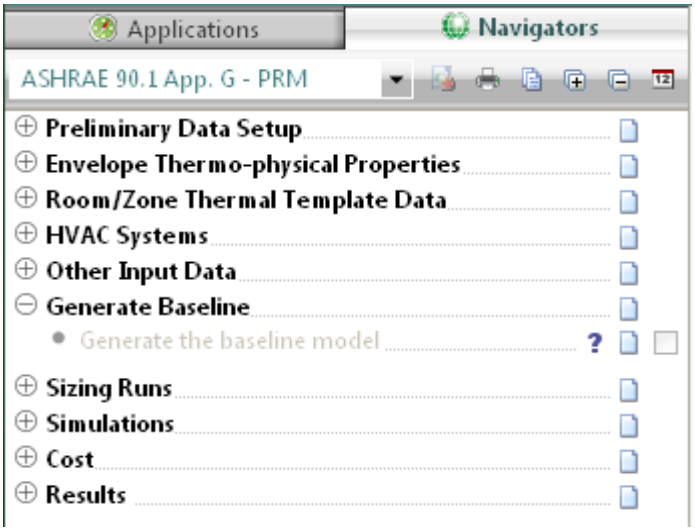
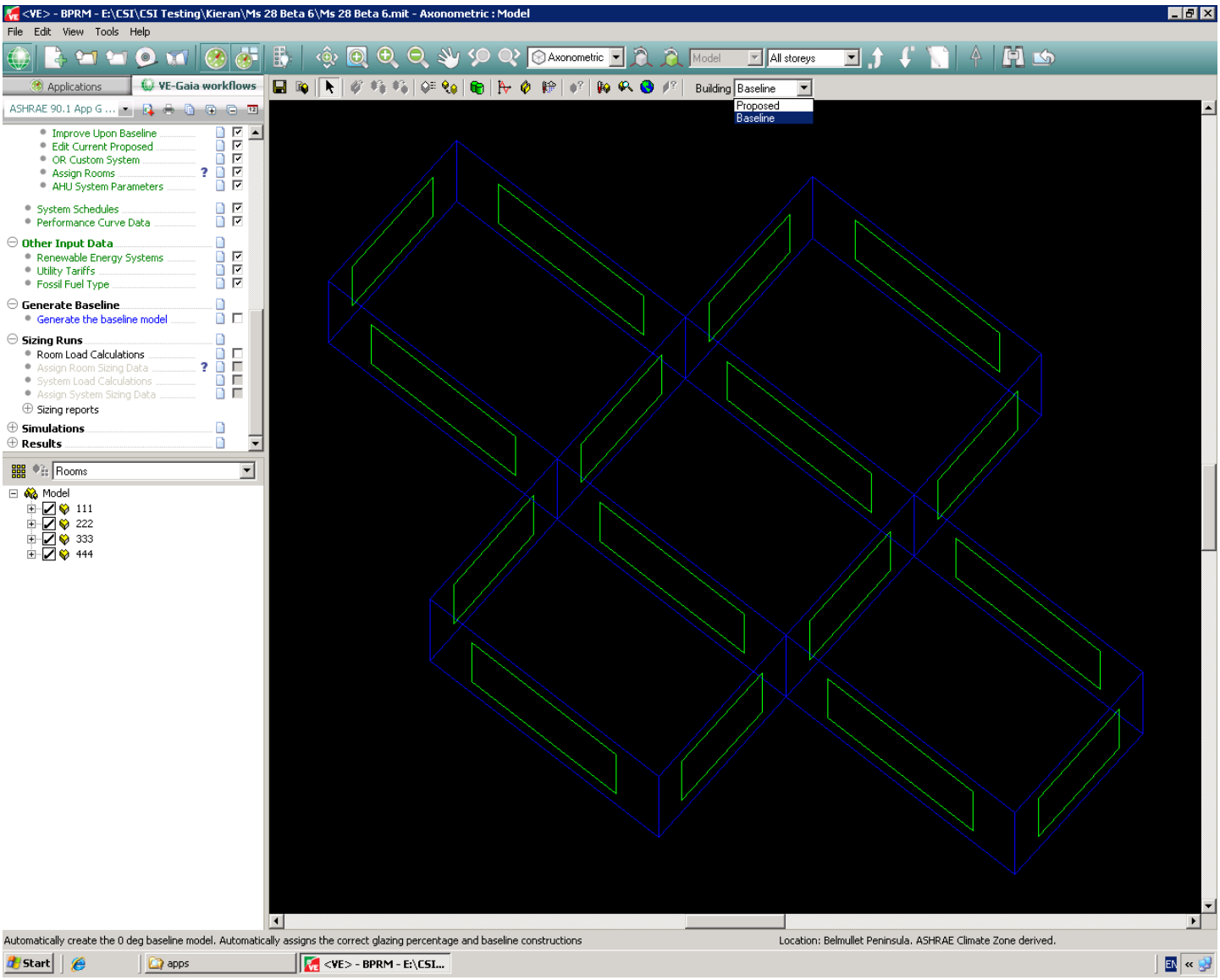


Figure 41 - Generate Baseline Tasks

Generate the Baseline Model

This navigator step automatically generates the baseline models & assigns all relevant baseline information created in previous navigator steps/stages.

Note: This is a very important step in the navigator workflow as it essentially assigns all model data setup in previous navigator steps. If any changes are made to navigator steps after the generation of the baseline models, the baseline models must be re-generated in order to assign updated model data i.e. lighting, ventilation rates, occupancy etc.
Baseline sizing runs will also need to be rerun if changes effect space loads i.e. Lighting, ventilation rates, occupancy etc. If data changes post “baseline generation” do not affect space loads (i.e. exterior lighting) users must still re-do the following navigator steps “Assign room sizing data” & “update fan & coil sizing data”.



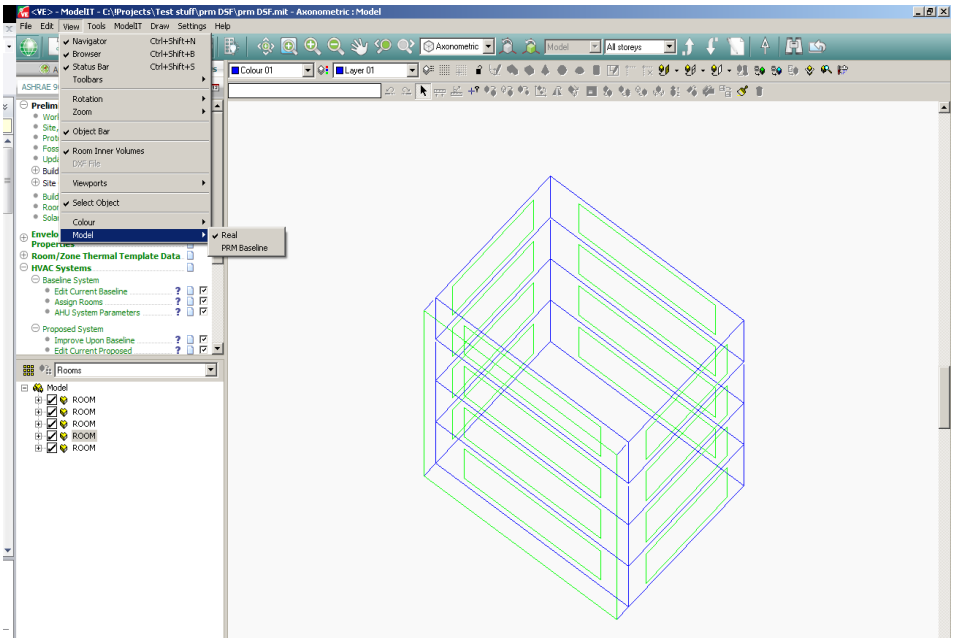
Once the baseline models have been generated users can toggle between the Proposed & Baseline geometry. See above.

Special Baseline Geometry Edits

It might be necessary to make custom geometry edits to the baseline model due to the ASHRAE 90.1 modeling rules. For example if the proposed model has a double skin façade it is required that the baseline model excludes this building feature. The following steps must be followed in order to make custom edits to the baseline model geometry.

- Enter ModelIt and switch to Baseline model by selecting “view” model in the main tool bar.
- Delete the double-skin façade geometry from the baseline model.

- Return to the BPRM view.
- At this point the newly exposed facade will have default VE constructions assigned. You must manually assign the baseline exterior wall constructions for this facade.
- Once the facade constructions have been assigned, the 0 deg baseline model geometry and construction assignment should now be correct.
- IF *after* removing the double-skin façade the overall window-to-wall ratio for the entire baseline building exceeds 40%, the newly exposed glazing on facades where the DSF was removed will need to be downsized until the overall 40% requirement is met. (If the proposed building had greater than 40% WWR prior to generating the Baseline building, the glazing area on all *exterior* facades will have been automatically reduced to meet the requirement.)
- For user that have previously generated the other baseline orientations by running Room Load Calculations after generating the baseline model, these other orientations must be refreshed. This is will be dealt with by running the Room Load calculations in a later step. As these other baseline orientations are based on the 0-degree baseline, there will be no need to repeat the steps above.



11. Sizing Runs

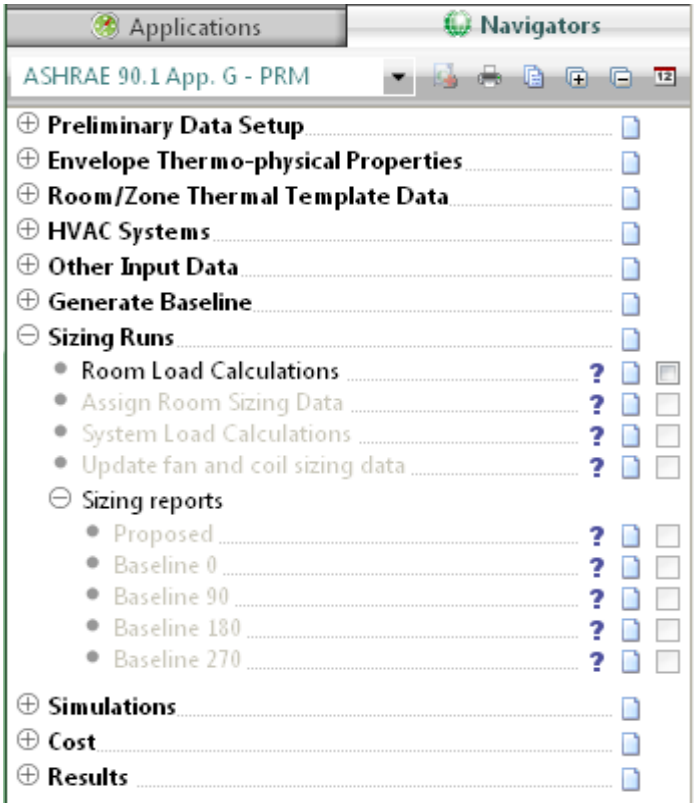
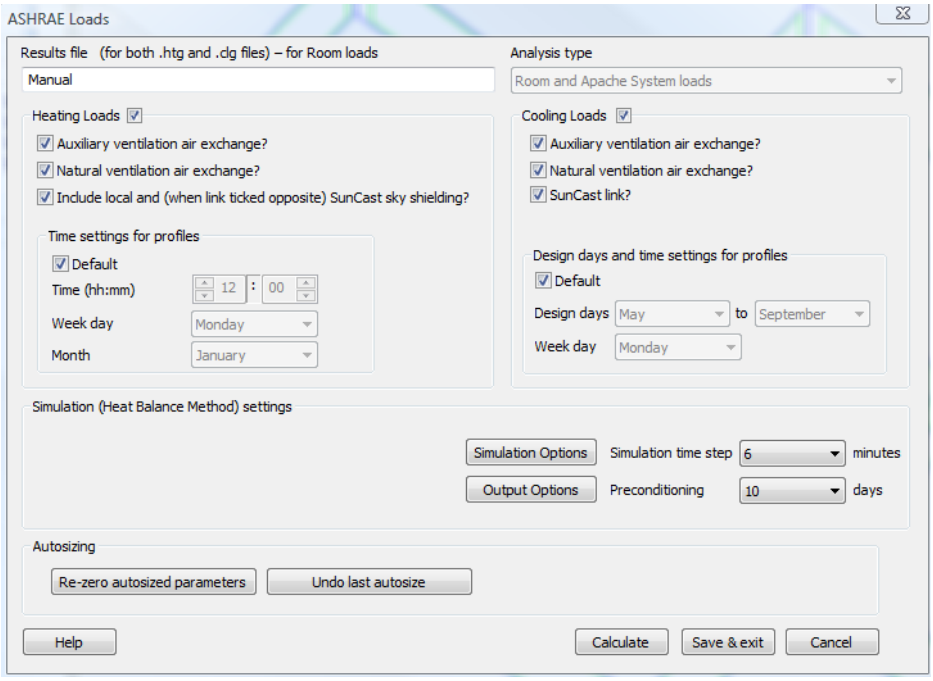


Figure 42 - Sizing Runs Sub-categories and Tasks

Room Load Calculations

This navigator step automatically opens up the ApacheLoads dialog with default information applied. The user can edit the information relating to the proposed model. The four baseline runs are generated automatically.



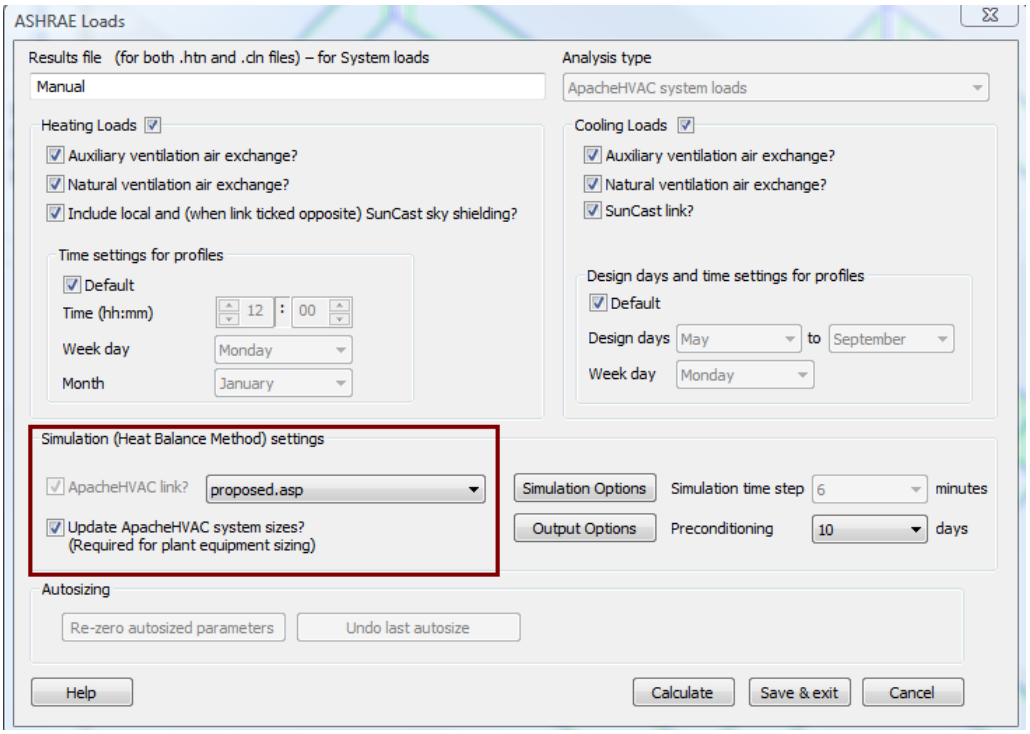
As with a normal ApacheLoads run this will generate information relating to room heating and cooling loads. This information is then used to populate the default PRM sizing sheets located in the 'Loads Data' folder of the project directory. This will generate flowrate data for use in the proposed and baseline HVAC networks.

Assign Room Sizing Data

This step automatically assigns the sizing data generated from the step above to the proposed and baseline HVAC networks.

System Load Calculations

This navigator step opens up the ApacheLoads dialog again, this time an ApacheHVAC network is assigned in order to enable a system sizing calculation. This will provide information to size various system elements i.e. fan and coil data.



As above, the user can edit the information relating to the proposed model. The four baseline runs are generated automatically.

Update Fan And Coil Sizing Data

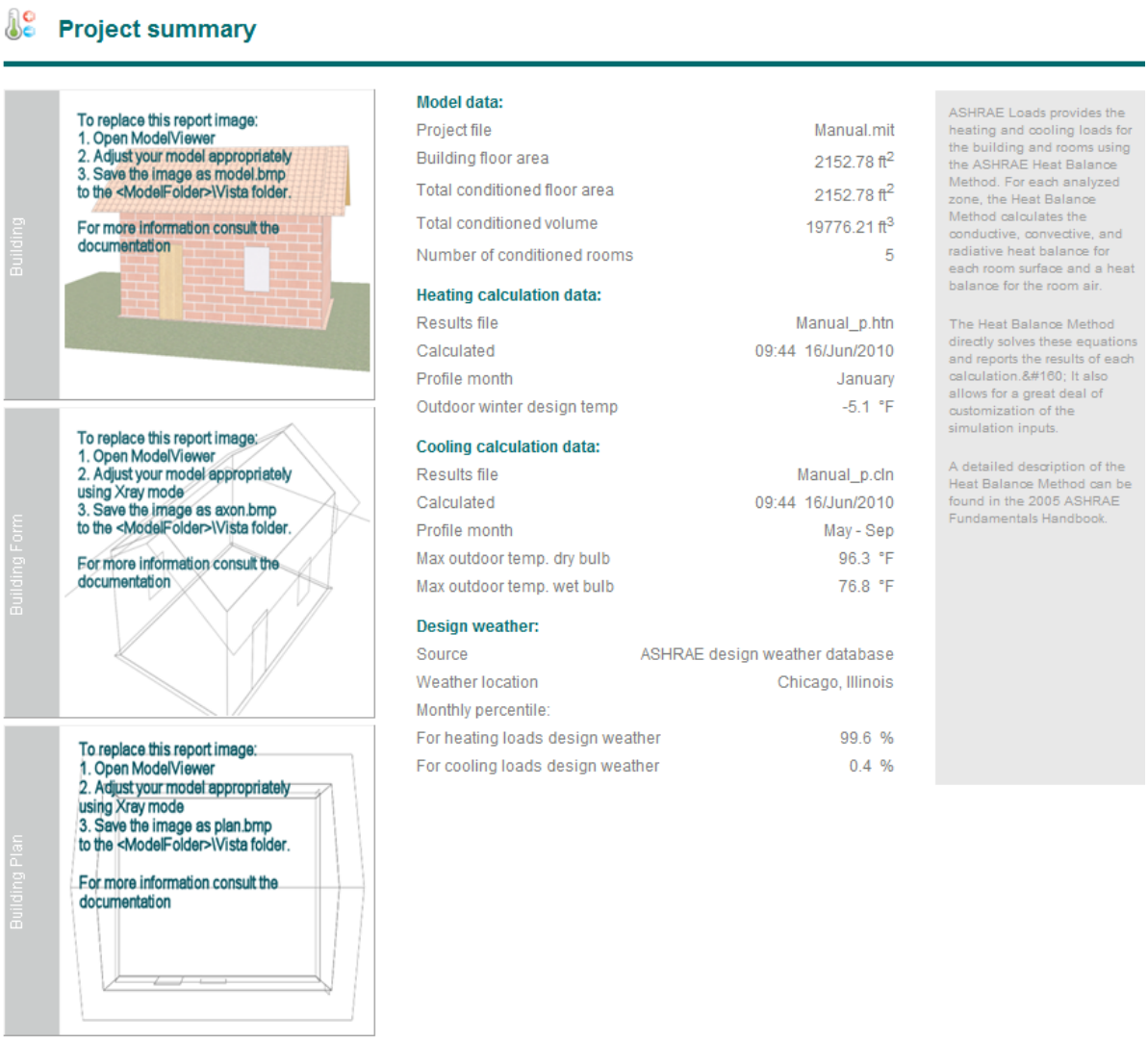
This step automatically assigns the sizing data generated from the step above to the proposed and baseline HVAC networks.

Sizing Reports

Proposed

This step enables the generation or display of a system level report for the proposed model. The report is broken down into three sections

Project Summary:



Project summary

Building

To replace this report image:
1. Open ModelViewer
2. Adjust your model appropriately
3. Save the image as model.bmp
to the <ModelFolder>\Vista folder.

For more information consult the documentation

Building Form

To replace this report image:
1. Open ModelViewer
2. Adjust your model appropriately using Xray mode
3. Save the image as axon.bmp
to the <ModelFolder>\Vista folder.

For more information consult the documentation

Building Plan

To replace this report image:
1. Open ModelViewer
2. Adjust your model appropriately using Xray mode
3. Save the image as plan.bmp
to the <ModelFolder>\Vista folder.

For more information consult the documentation

Model data:

Project file	Manual.mit
Building floor area	2152.78 ft^2
Total conditioned floor area	2152.78 ft^2
Total conditioned volume	19776.21 ft^3
Number of conditioned rooms	5

Heating calculation data:

Results file	Manual_p.htn
Calculated	09:44 16/Jun/2010
Profile month	January
Outdoor winter design temp	-5.1 °F

Cooling calculation data:

Results file	Manual_p.cln
Calculated	09:44 16/Jun/2010
Profile month	May - Sep
Max outdoor temp. dry bulb	96.3 °F
Max outdoor temp. wet bulb	76.8 °F

Design weather:

Source	ASHRAE design weather database
Weather location	Chicago, Illinois
Monthly percentile:	
For heating loads design weather	99.6 %
For cooling loads design weather	0.4 %

ASHRAE Loads provides the heating and cooling loads for the building and rooms using the ASHRAE Heat Balance Method. For each analyzed zone, the Heat Balance Method calculates the conductive, convective, and radiative heat balance for each room surface and a heat balance for the room air.

The Heat Balance Method directly solves these equations and reports the results of each calculation. It also allows for a great deal of customization of the simulation inputs.

A detailed description of the Heat Balance Method can be found in the 2005 ASHRAE Fundamentals Handbook.

Contains information relating to the project area and volume, input data for the sizing calculations and design weather data.

System Sizing Plant Loads:

SYSTEM SIZING plant loads

Heating Plant

Equipment Name	Equipment Type	Area served (ft^2)	Peak Load (kBtu/h)	Time of Peak
BR000023	2 Non-Condensing Boilers, sequenced, Primary Loop, Variable-spd pump	2152.8	84.2	Sized during heating

Cooling Plant

Equipment Name	Equipment Type	Area served (ft^2)	Peak Load (kBtu/h)	Time of Peak
CR000001	EWC Chiller with default values and VSD sec'd pump, 2-sp clg tower fan	2152.8	130.2	8/1516:30

Contains information relating to the overall performance of the heating and cooling systems e.g. the system type, the floor area served and peak load occurrence.

System Sizing System Loads:

SYSTEM SIZING system loads

System Loads

System Name	System Type	Area Served (ft^2)
PR07_034	VAV with Reheat - Office	2152.8

Coil Sizes	AHU Cooling Coil Sensible Load (kBtu/h)	AHU Cooling Coil Latent Load (kBtu/h)	AHU Cooling Coil Total Load (kBtu/h)	AHU Heating Coil Total Load (kBtu/h)
Peak value	120.1	10.1	130.2	0.0
Time of Peak	8/1516:30	8/1516:30	8/1516:30	

Fan Sizes	AHU Supply Fan Flow (cfm)	AHU Return Fan Flow (cfm)	Optional Exhaust Fan Flow (cfm)	Min Vent Airflow (cfm)
Peak Value	5589.2	5589.2	0.0	191.6
Time of Peak	7/1516:30	7/1516:30		

Engineering Checks	Cooling Checks			Heating Checks		
	cfm/ft^2	Btu/h•ft^2	% OA	cfm/ft^2	Btu/h•ft^2	% OA
Peak Value	2.6	60.5	3.5	0.0	39.11	0.0
Time of Peak	8/1516:30	Calculated at time of Peak Cooling Coil Load			Calculated at time of Peak Heating Coil Load	

Rooms Served by System	Components					Airflows			
	Cooling Coil Sensible Load (kBtu/h)	Cooling Coil Latent Load (kBtu/h)	Cooling Coil Total Load (kBtu/h)	Heating Coil Total Load (kBtu/h)	Zone recirc Fan Flow (cfm)	Maximum Flow (cfm)	Minimum Flow (cfm)	Exhaust Flow (cfm)	OA Flow (cfm)
Office	-	-	-	8.20	-	567.2	172.2	0.0	45.1
Office	-	-	-	17.60	-	1095.0	172.2	0.0	45.1
Office	-	-	-	20.30	-	1414.4	172.2	0.0	45.1
Office	-	-	-	20.30	-	1392.3	172.2	0.0	45.1
Office	-	-	-	17.80	-	1380.0	172.2	0.0	45.1

Contains detailed information relating to performance of each individual system including sizing data relating to each individual room served by the system.

The report includes data regarding the sizing of the following:

- Heating and cooling coils
- Supply fans
- Return fans
- Exhaust fans
- Outside air ventilation rates
- Zone heating coils (reheat)
- Zone airflow rates

The System Sizing report also includes an Engineering Checks section.

Baseline 0°
The report contains data relating to the Baseline 0° model sizing runs.

Baseline 90°
The report contains data relating to the Baseline 90° model sizing runs.

Baseline 180°
The report contains data relating to the Baseline 180° model sizing runs.

Baseline 270°
The report contains data relating to the Baseline 270° model sizing runs.

Setting Baseline HVAC/DHW manual inputs

Once sizing runs have been performed & auto-sized data has been assigned to the HVAC networks users are required to make some manual edits to the baseline HVAC network in order to comply with ASHRAE 90.1 rules. (These will be autosized/set in future releases).

1. Set baseline “heating source” minimum efficiency. See ASHRAE 90.1 tables 6.8.1A to 6.8.1F. The baseline system efficiency is dependent on the heating plant load; users should use the baseline sizing calculations to determine the required efficiency.

2. Number of baseline boilers if systems 1, 5 or 7 are being modeled. See ASHRAE 90.1 G3.1.3.2. If two boilers are required the boiler Qrat input must be divided by two.

3. Set baseline hot water pump type i.e. Variable speed or constant speed based as per ASHRAE 90.1 section G3.1.3.5.

4. Set chiller plant minimum efficiency as per tables 6.8.1A to 6.8.1F. The baseline system efficiency is dependent on the cooling plant load; users should use the baseline sizing calculations to determine the required efficiency.

5. Set number & type (screw or centrifugal) of baseline chillers for systems 7 & 8 as per ASHRAE 90.1 table G3.1.3.7.

6. Select chilled water reset as per ASHRAE 90.1 G3.1.3.9 ruling.

7. Set chilled water baseline pump type i.e. Variable speed or constant speed based as per ASHRAE 90.1 section G3.1.3.10.

8. Set baseline heat rejection requirements as per ASHRAE 90.1 G3.1.3.11 (system 7 & 8 only).

9. Set baseline condenser heat recovery if required as per ASHRAE 90.1 section 6.5.6.2.1.

10. Users are required to manually set the SHW plant efficiency as per section 7 of ASHRAE 90.1. The boiler tab in ApHVAC contains a prototype SHW system that should be used for the baseline SHW. Users will need to tick the “Use for DHW” & open the heat source & set the required baseline efficiency.

11. Airside economizers need to be engaged for each system air handler, as required by ASHRAE 90.1 G3.1.2.6, via the AHU Parameters dialog prior to system autosizing.

12. Exhaust air energy recovery needs to be engaged and appropriate recovery effectiveness set for each system air handler, as required by ASHRAE 90.1 G3.1.2.10, via the AHU Parameters dialog prior to system autosizing.

13. DX Cooling autosizing is applied to the DX Coil component and this, by default, is set to override the capacity that has been pre-set in the DX Cooling types dialog. This scales the performance curves in the types dialog as needed to match the size of each DX Cooling instance for that type. The DX Cooling types are set up to match ASHRAE 90.1 COP values (fan-power having been removed from EER values provided in ASHRAE Table 6.8.1A, 6.8.1B, and 6.8.1D) for each ASHRAE size range.
    - For systems 3, 5, and 6, these are dynamically re-assigned as needed to match appropriate COPs with the sized DX cooling unit.
    - For systems 1, 2, and 4, until the same level of automation is provided within the software, users will need to manually check within the Cooling Coil dialog and, if needed, change the selection of pre-defined DX Cooling Type to match the equipment (PTHP vs. PTAC and PSZ-HP vs. PSZ-AC) and COP for the autosized component to those in ASHRAE tables 6.8.1B and 6.8.1D). Again, the COP values

for the rated condition in the pre-defined DX Types are based upon the EER values from the ASHREA tables, with fan power having been removed.

14. Air-Source Heat Pumps in System 2 (PTHP) are set up, by default, with ten COP and capacity values forming a performance curve in relation to outdoor temperature (ASHRAE value at rated condition, sans SA fan power, adjusted according to ASHRAE standard performance curves and assumed part-load operation above a 32 °F thermal balance point) to match equipment with capacity in the range of 7-15 kBtu/h (2.05-4.4 kW). For PTHP systems with either lesser or greater capacity, until this is automated in the software, users must replace the COP values in the Heat Pump component dialog with the appropriate set from *Appendix B: HVAC Systems Modeling Guidance Specific to ANSI/ASHRAE/IESNA Standard 90.1-2007* in the ApacheHVAC User Guide. There are just three capacity ranges for PTHP heating mode COPs in ASHRAE 90.1-2007.
    - Tip: Select just the multiplex layers with Heat Pump components that have an autosized capacity (value on the 10th row at 47 °F) that is either less than or greater than 7-15 kBtu/h (but not both). Then, while in multiplex Global Edit mode, revise the ten COP values simultaneously for all of these.

15. Air-Source Heat Pumps in System 4 (PSZ-HP), similar to system-2 heat pumps, are set up, by default, with 10 COP and capacity values forming a performance curve in relation to outdoor temperature (ASHRAE value at rated condition, sans SA fan power, adjusted according to ASHRAE standard performance curves and assumed part-load operation above a 32 °F thermal balance point) to match equipment with capacity in the range of 65-135 kBtu/h (2.05-4.4 kW). For PSZ-HP systems with either lesser or greater capacity, until this is automated in the software, users must replace the COP values in the Heat Pump component dialog with the appropriate set from *Appendix B: HVAC Systems Modeling Guidance Specific to ANSI/ASHRAE/IESNA Standard 90.1-2007* in the ApacheHVAC User Guide. There are just three capacity ranges for PSZ-HP heating mode COPs in ASHRAE 90.1-2007.
    - Tip: Select just the multiplex layers with Heat Pump components that have an autosized capacity (value on the 10th row at 47 °F) in a capacity range lesser or greater than 65-135 kBtu/h (but not both) and, while in Global Edit mode, revise the ten COP values simultaneously for all of these. If there are Heat Pumps with autosized capacity in a yet another ASHRAE capacity range, change the multiplex layer selection to include just these layers and repeat the global edit of COP values.

16. For detailed information on baseline HVAC modelling requirements please refer to ASHRAE 90.1 section 6 & Appendix G.

Note: For cases where the Proposed SHW & heating plant are served by the same boiler system the automatic report generator will not match the vista fuel code results, as certain vista energy results are post-proceeded in order to separate the SHW & heating fossil fuel loads.

12. Simulations

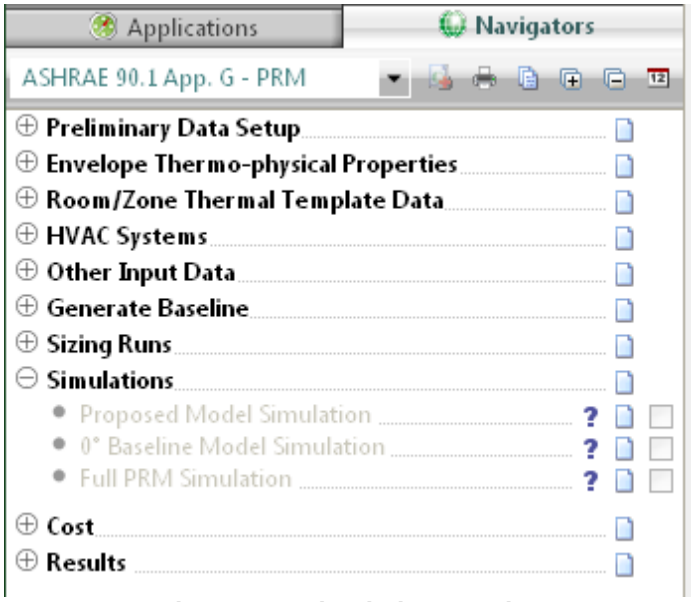
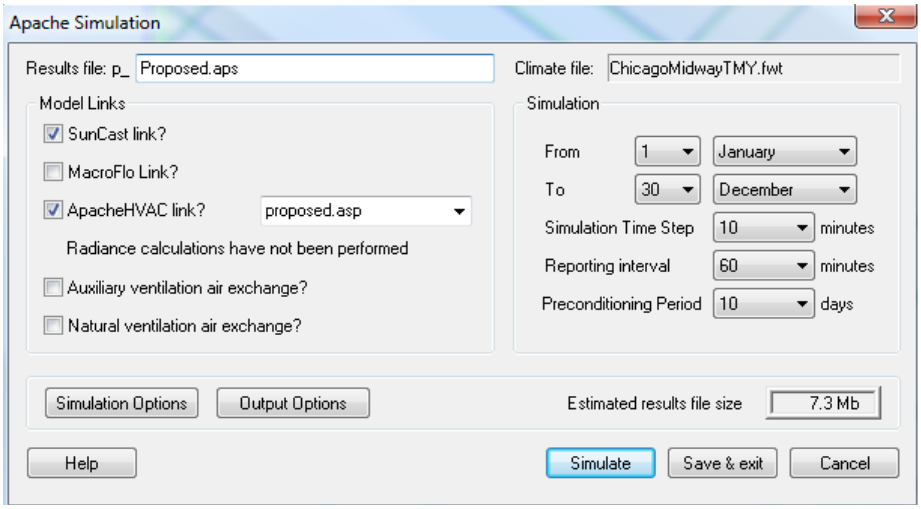


Figure 43 - Simulations Tasks

Proposed Model Simulation

This step allows the user to set up a full annual simulation for the proposed model. Ensure that the correct model links and the correct Apache HVAC file are selected. Ensure that the simulation time is set from 1st Jan – 31st Dec.



0° Baseline Model Simulation

This step will automatically run a full annual simulation for the 0° baseline model.

Full PRM Simulation

This step will run a full annual simulation for the proposed and all four baseline models. The user is required to set up data relating to the proposed simulation. The four baseline simulations are run automatically.

Macroflo & the PRM navigator

In order to link the VE Macroflo module into the PRM navigator users must first run the “Full PRM simulation” with the Macroflo link ticked off. Once the full simulation is complete users must then run the “Proposed model simulation” with the Macroflo link ticked on. The proposed simulation must be run again with the same simulation name so that it over writes the first proposed results file.

13. Cost

Please refer to the tariff analysis tool please refer to the “Tariff analysis user guide”.

14. Results

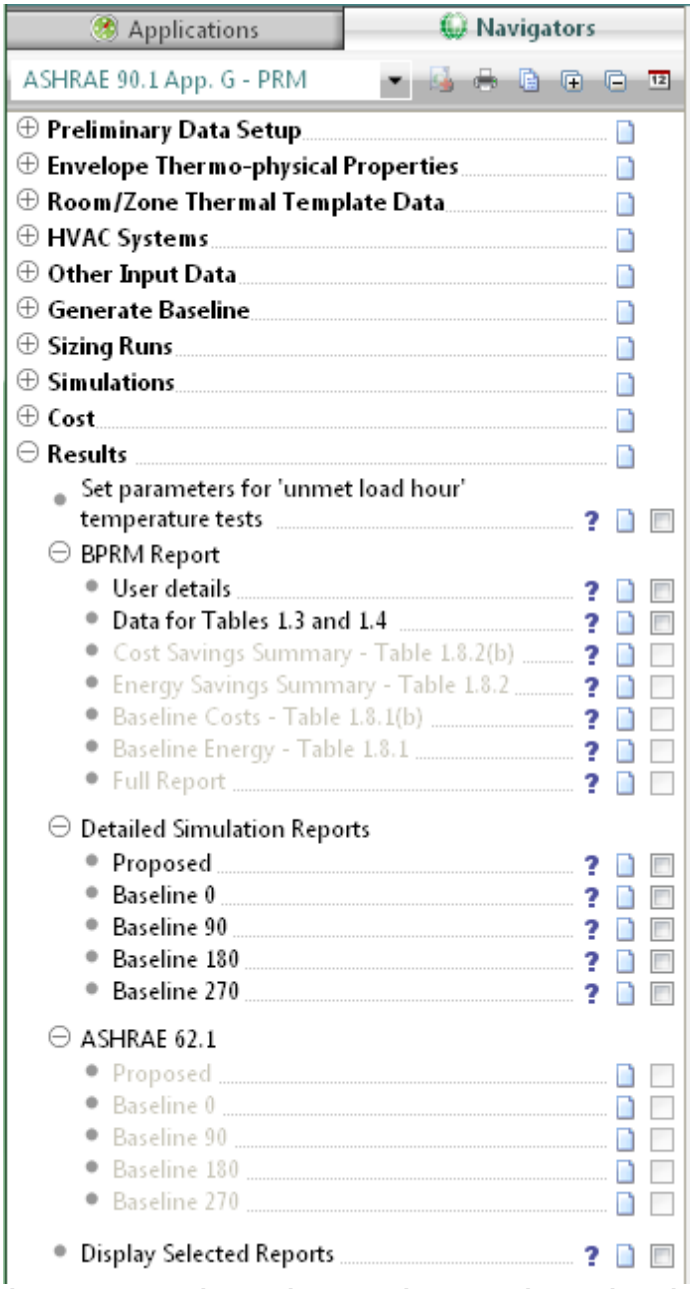


Figure 44 - Results Navigator Sub-categories and Tasks

Set Parameters For "Unmet Load Hour" Temperature Tests

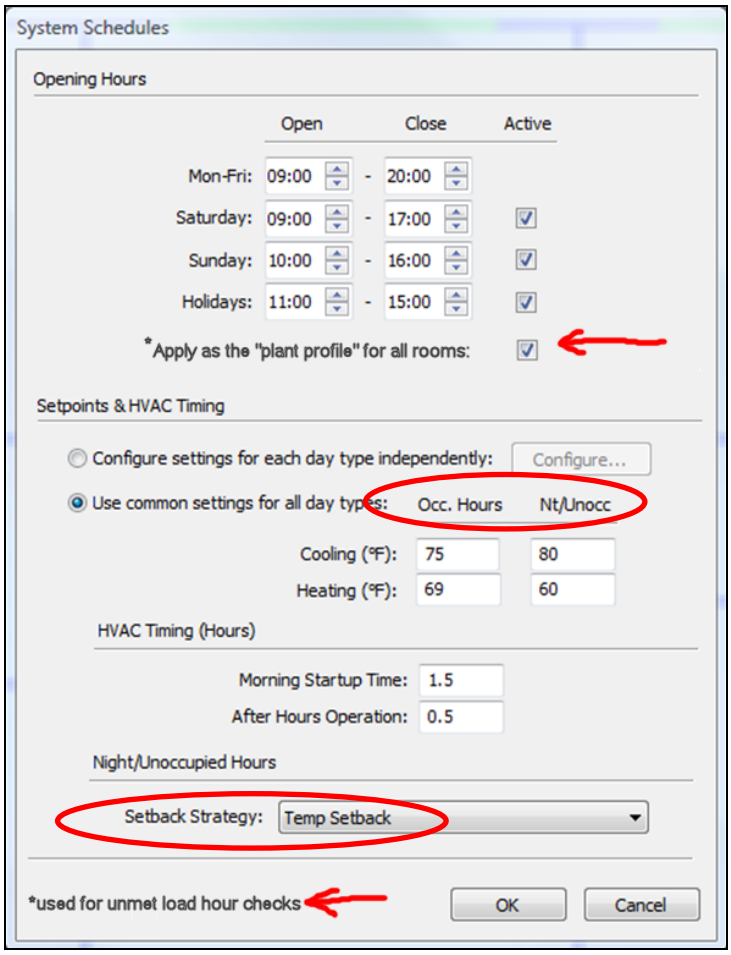
Section G3.1.2.2 of ASHRAE 90.1 2007 states "Unmet load hours for the *proposed design* or *baseline building designs* shall not exceed 300 (of the 8760 hours simulated), and unmet load hours for the *proposed design* shall not exceed the number of unmet load hours for the *baseline building design* by more than 50. If unmet load hours in the *proposed design* exceed the unmet load hours in the *baseline building* by more than 50, simulated capacities in the *baseline building* shall be decreased incrementally and the building re-simulated until the unmet load hours are within 50 of the unmet load hours of the *proposed design*. If unmet load hours for the *proposed design* or *baseline building design* exceed 300, simulated capacities shall be increased incrementally, and the building with unmet loads re-simulated until unmet load hours are reduced to 300 or less. Alternatively, unmet load hours exceeding these limits may be accepted at the discretion of the *rating authority* provided that sufficient justification is given indicating that the accuracy of the simulation is not significantly compromised by these unmet loads."

The "unmet load hours" can be calculated in two different places in the VE:

1. From the **PRM navigator "Unmet load hours report"**
2. From the **Range test dialog in Vista**, using the heating & cooling set points, and the logical "OR" shared hours test. Currently, the user must click "Occupied hours only" as well.

See below detail for the above two approaches.

PRM Navigator "Unmet load hours"
When using the PRM navigator the range of hours tested to meet the unmet load hour requirements are defined within the "system schedule" dialogue.

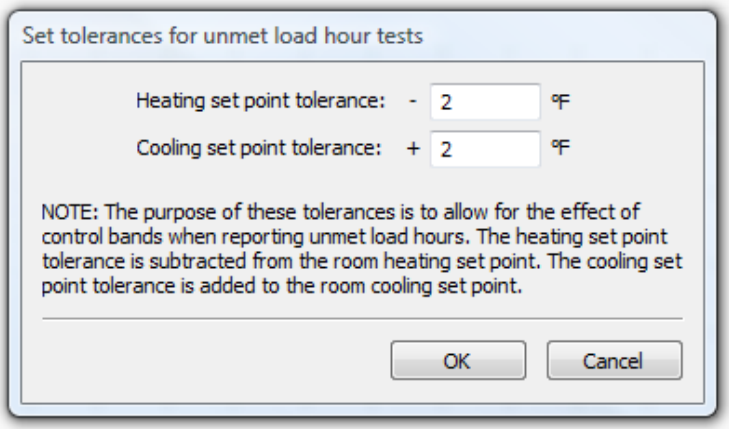


If “Apply as the ‘plant profile’ for all rooms” is left as ‘ticked’ then it will create a new annual profile named ‘Plant-conditioning times’ which will be assigned as the ‘Plant profile’ for all rooms. This profile will provide just two things to the actual unmet load hours test:

1. The *opening* hours, and thus a means of shifting the effective times that the times heating and cooling set points switch from Occ to Nt/Unocc set point values
2. The times for which the HVAC will actually be OFF (it is rare to allow this outside of very mild climates).

In other words, while modelling of the HVAC system operation needs to use the Occ set points over the larger number of hours that include warm-up and wind-down, the Unmet Load Hours test needs to use these more stringent set points over a shorter period of each day (just the opening hours) This test must assume the rest set points to be at the unoccupied values during the warm-up and wind-down. It should stop counting unmet load hours outside of occupied times *only* when the selected Setback Strategy is “HVAC Off”.

Once the above information has been set users are also prompted in a later navigator step to set tolerances for the unmet load hour check.

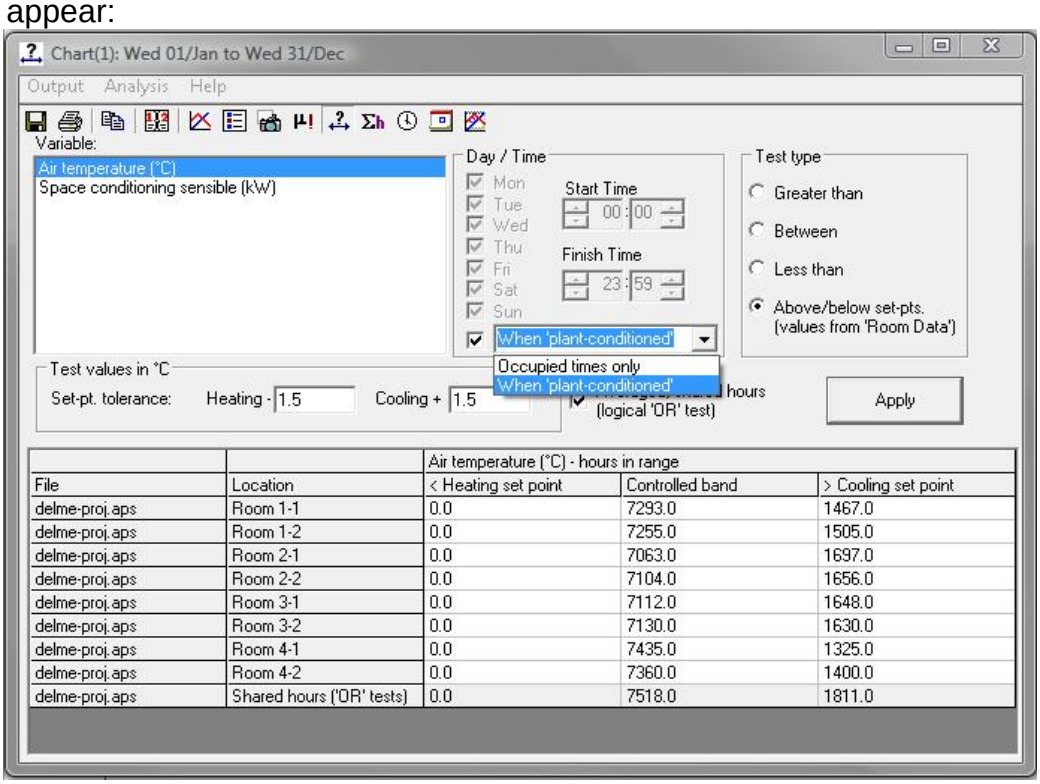


The purpose of these tolerances is to allow for the effect of control bands when reporting unmet load hours. The heating set point tolerance is subtracted from the room heating set point. The cooling set point is added to the room cooling set point.

Range test dialogue in Vista

It may be necessary to manually check the unmet load hours for models that do not have a common heating & cooling set point for all model spaces. This means that a manual approach must be implemented for spaces with common heating & cooling set points. ?

This manual approach uses the range test feature within the Vista results analysis tool to perform the unmet load hour's check. Users must select the required model rooms or groups of rooms they wish to test & then select the range test icon in the main Vista results analysis tool bar. The below interface will appear:



Users must select the “when plant conditioned” from the above drop down window & set the heating cooling tolerance ranges before clicking the apply button. Once the “apply” button has been clicked the user will be presented with results.
Using this approach means that users will have to manually create the LEED results table 1.3 for submittal & that the automated result table 1.3 generated when the reportage button is activated is now redundant.

BPRM Report

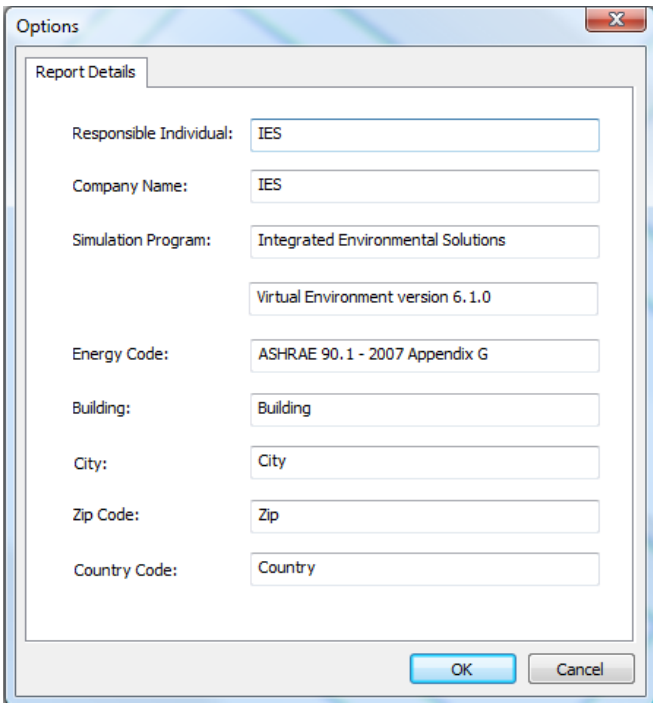
BPRM results are presented in a format similar to the standard LEED letter template.

Initially user specified information is entered.

The Navigator then generates individual tables from within the report. Finally the BPRM report can be generated in full.

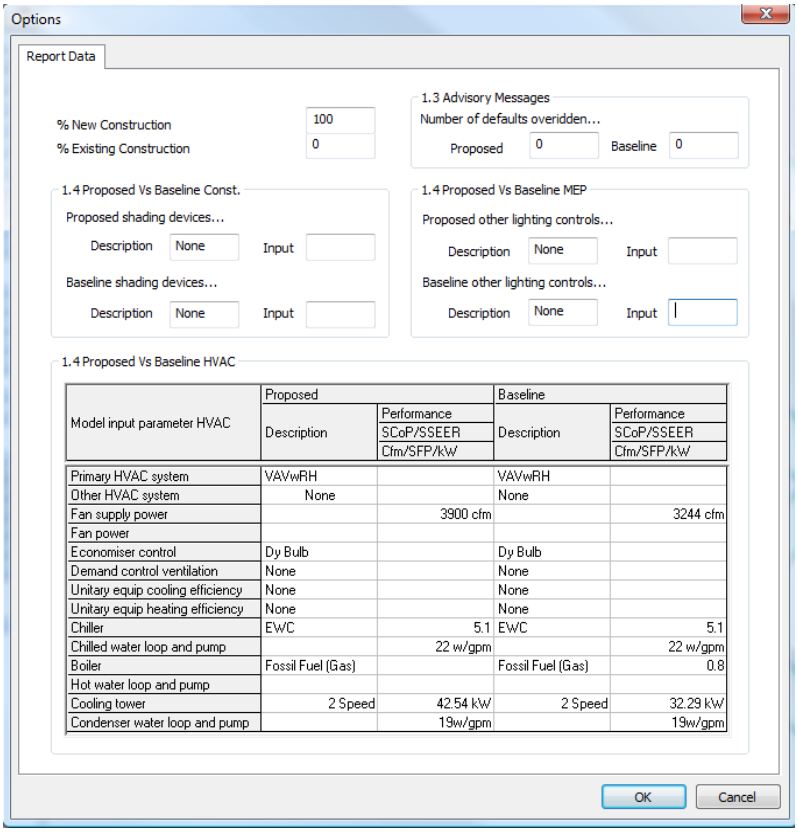
User Details

Input user details for use in the full BPRM report.



Data For Tables 1.3 and 1.4

Certain data relating to tables 1.3 and 1.4 has to be entered manually. Information entered here will be shown in the full BPRM report.



Options

Report Data

% New Construction: 100
% Existing Construction: 0

1.3 Advisory Messages
Number of defaults overidden...
Proposed: 0 Baseline: 0

1.4 Proposed Vs Baseline Const.
Proposed shading devices...
Description: None Input:
Baseline shading devices...
Description: None Input:

1.4 Proposed Vs Baseline MEP
Proposed other lighting controls...
Description: None Input:
Baseline other lighting controls...
Description: None Input:

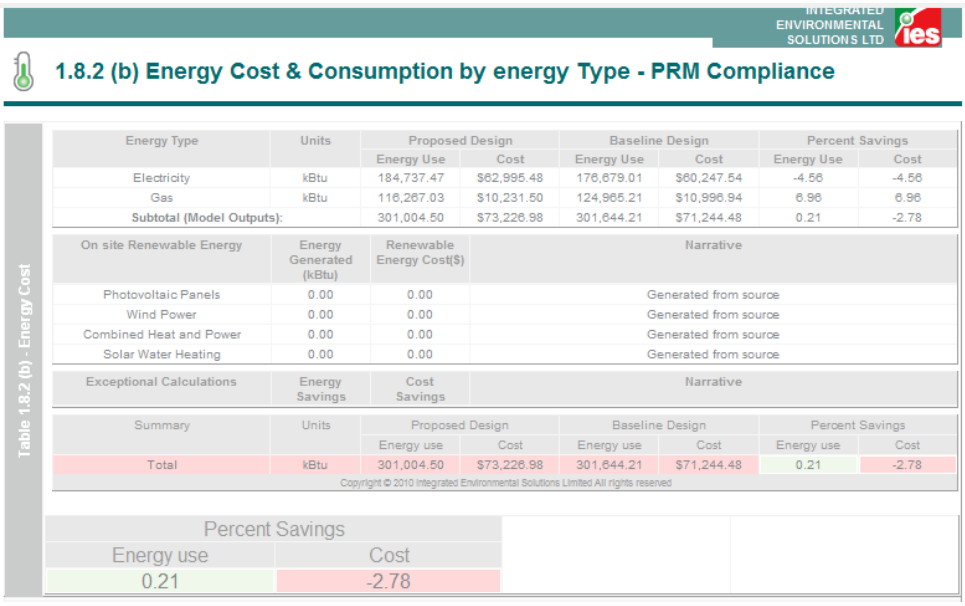
1.4 Proposed Vs Baseline HVAC

Model input parameter HVAC	Proposed		Baseline	
	Description	Performance SCoP/SSEER Cfm/SFP/kW	Description	Performance SCoP/SSEER Cfm/SFP/kW
Primary HVAC system	VAVwRH		VAVwRH	
Other HVAC system	None		None	
Fan supply power		3900 cfm		3244 cfm
Fan power				
Economiser control	Dy Bulb		Dy Bulb	
Demand control ventilation	None		None	
Unitary equip cooling efficiency	None		None	
Unitary equip heating efficiency	None		None	
Chiller	EWC	5.1	EWC	5.1
Chilled water loop and pump		22 w/gpm		22 w/gpm
Boiler	Fossil Fuel (Gas)		Fossil Fuel (Gas)	0.8
Hot water loop and pump				
Cooling tower	2 Speed	42.54 kW	2 Speed	32.29 kW
Condenser water loop and pump		19w/gpm		19w/gpm

OK Cancel

Cost Savings Summary – Table 1.8.2(b)

Table 1.8.2(b), the cost savings summary table, is presented.



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1.8.2 (b) Energy Cost & Consumption by energy Type - PRM Compliance

Table 1.8.2 (b) - Energy Cost

Energy Type	Units	Proposed Design		Baseline Design		Percent Savings	
		Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
Electricity	kBtu	184,737.47	$62,995.48	176,679.01	$60,247.54	-4.56	-4.56
Gas	kBtu	116,267.03	$10,231.50	124,965.21	$10,996.94	6.96	6.96
Subtotal (Model Outputs):		301,004.50	$73,226.98	301,644.21	$71,244.48	0.21	-2.78

On site Renewable Energy	Energy Generated (kBtu)	Renewable Energy Cost($)	Narrative
Photovoltaic Panels	0.00	0.00	Generated from source
Wind Power	0.00	0.00	Generated from source
Combined Heat and Power	0.00	0.00	Generated from source
Solar Water Heating	0.00	0.00	Generated from source

Exceptional Calculations	Energy Savings	Cost Savings	Narrative

Summary	Units	Proposed Design		Baseline Design		Percent Savings	
		Energy use	Cost	Energy use	Cost	Energy use	Cost
Total	kBtu	301,004.50	$73,226.98	301,644.21	$71,244.48	0.21	-2.78

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Percent Savings	
Energy use	Cost
0.21	-2.78

Energy Savings Summary – Table 1.8.2

Table 1.8.2, the energy savings summary table, is presented.

1.8.2 Performance Rating Table - PRM Compliance

Table 1.8.2 - Performance Rating

End Use	Process	Proposed Design Energy Type	Proposed Design Units	Proposed Building Results	Baseline Design Units	Baseline Building Results	Percent Savings %
Internal Lighting	No	Electricity	Energy use kBtu	17,171.17	Energy use kBtu	23,612.85	27.3
			Demand MBH	5.29	Demand MBH	7.27	27.3
Exterior Lighting	No	Electricity	Energy use kBtu	87,282.74	Energy use kBtu	91,646.88	4.8
			Demand MBH	17.57	Demand MBH	18.45	4.8
Space Heating (Fossil Fuel)	No	Gas	Energy use kBtu	116,267.03	Energy use kBtu	124,965.21	7.0
			Demand MBH	104.36	Demand MBH	105.13	0.7
Space Heating	No	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Space Cooling	No	Electricity	Energy use kBtu	20,612.81	Energy use kBtu	11,230.01	-83.6
			Demand MBH	19.73	Demand MBH	13.76	-43.4
Pumps	No	Electricity	Energy use kBtu	1,286.92	Energy use kBtu	748.58	-71.9
			Demand MBH	1.39	Demand MBH	1.09	-27.0
Heat Rejection	No	Electricity	Energy use kBtu	6,427.01	Energy use kBtu	3,308.46	-94.3
			Demand MBH	4.26	Demand MBH	2.35	-81.5
Fans Interior	No	Electricity	Energy use kBtu	19,758.38	Energy use kBtu	13,933.80	-41.8
			Demand MBH	17.24	Demand MBH	10.01	-72.3
Fans Parking Garage	No	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Service Water Heating (Fossil Fuel)	No	Gas	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Service Water Heating	No	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Receptacle Equipment	Yes	Electricity	Energy use kBtu	32,198.44	Energy use kBtu	32,198.44	0.0
			Demand MBH	9.92	Demand MBH	9.92	0.0
Interior Lighting Process	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Refrigeration	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Data Centre Equipment	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Cooking (Fossil Fuel)	Yes	Gas	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Cooking	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Elevators Escalators	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Other Processes	Yes	Electricity	Energy use kBtu	0.00	Energy use kBtu	0.00	0.0
			Demand MBH	0.00	Demand MBH	0.00	0.0
Total Annual Energy Use kBtu/year				301,004.50		301,644.21	0.2
Total Process Energy kBtu/year				32,198.44		32,198.44	0.0

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Baseline Costs – Table 1.8.1(b)

Table 1.8.1(b), the baseline costs table, is presented.

1.8.1 (b) Baseline Energy Costs

Table 1.8.1 (b) - Baseline Energy Costs

Energy Type	Baseline 0 rotation	Baseline 90 rotation	Baseline 180 rotation	Baseline 270 rotation	Baseline Building Performance
Electricity	$60,122.14	$60,227.84	$60,408.02	$60,232.17	$60,247.54
Gas	$11,039.59	$11,016.28	$10,927.40	$11,004.49	$10,996.94
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
-	$0.00	$0.00	$0.00	$0.00	$0.00
Total Baseline Costs:	$71,161.73	$71,244.12	$71,335.42	$71,236.65	$71,244.48

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Baseline Energy – Table 1.8.1

Table 1.8.1, the baseline energy table, is presented.

1.8.1 Baseline Performance

Table 1.8.1 - Baseline Performance - PRM

End Use	Process	Baseline Design Energy Type	Units of Annual Energy & peak demand	Baseline 0 rotation	Baseline 90 rotation	Baseline 180 rotation	Baseline 270 rotation	Baseline Solution
Internal Lighting	No	Electricity	Energy use kBtu	23,612.85	23,612.85	23,612.85	23,612.85	23,612.85
			Demand MBH	7.27	7.27	7.27	7.27	7.27
Exterior Lighting	No	Electricity	Energy use kBtu	91,646.88	91,646.88	91,646.88	91,646.88	91,646.88
			Demand MBH	18.45	18.45	18.45	18.45	18.45
Space Heating (Fossil Fuel)	No	Gas	Energy use kBtu	125,449.86	125,184.95	125,050.97	124,175.04	124,965.21
			Demand MBH	105.05	104.93	104.96	105.57	105.13
Space Heating	No	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Space Cooling	No	Electricity	Energy use kBtu	11,623.45	11,184.06	11,134.10	10,978.42	11,230.01
			Demand MBH	13.60	13.94	14.01	13.50	13.76
Pumps	No	Electricity	Energy use kBtu	750.71	745.76	744.54	753.29	748.58
			Demand MBH	1.02	1.13	1.14	1.09	1.09
Heat Rejection	No	Electricity	Energy use kBtu	3,650.62	3,287.72	3,281.52	3,013.97	3,308.46
			Demand MBH	2.66	2.32	2.32	2.09	2.35
Fans Interior	No	Electricity	Energy use kBtu	12,828.33	13,945.53	14,015.60	14,945.76	13,933.80
			Demand MBH	11.11	10.14	10.04	8.75	10.01
Fans Parking Garage	No	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Service Water Heating (Fossil Fuel)	No	Gas	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Service Water Heating	No	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Receptacle Equipment	Yes	Electricity	Energy use kBtu	32,198.44	32,198.44	32,198.44	32,198.44	32,198.44
			Demand MBH	9.92	9.92	9.92	9.92	9.92
Interior Lighting Process	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Refrigeration	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Data Centre Equipment	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Cooking (Fossil Fuel)	Yes	Gas	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Cooking	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Elevators Escalators	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Other Processes	Yes	Electricity	Energy use kBtu	0.00	0.00	0.00	0.00	0.00
			Demand MBH	0.00	0.00	0.00	0.00	0.00
Total Annual Energy Use kBtu/year				301,761.12	301,806.18	301,324.65	301,684.89	301,644.21
Total Process Energy kBtu/year								32,198.44

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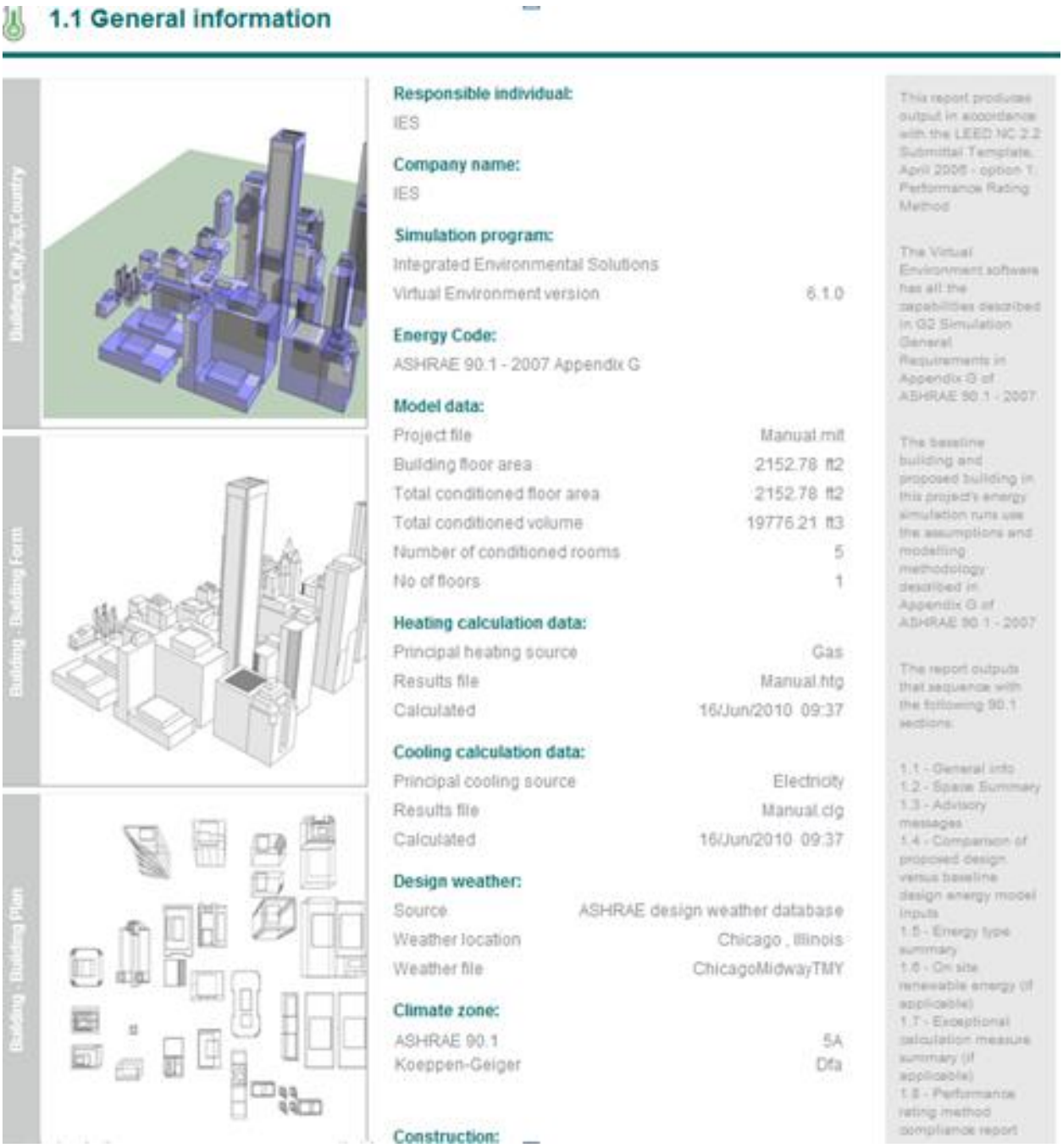
Full Report

The full BPRM report is generated containing all the above tables, plus

Table 1.1 - General Information



1.1 General information

Responsible individual:
IES

Company name:
IES

Simulation program:
Integrated Environmental Solutions
Virtual Environment version 6.1.0

Energy Code:
ASHRAE 90.1 - 2007 Appendix G

Model data:

Project file	Manual.mit
Building floor area	2152.78 ft2
Total conditioned floor area	2152.78 ft2
Total conditioned volume	19776.21 ft3
Number of conditioned rooms	5
No of floors	1

Heating calculation data:

Principal heating source	Gas
Results file	Manual.htg
Calculated	16/Jun/2010 09:37

Cooling calculation data:

Principal cooling source	Electricity
Results file	Manual.clg
Calculated	16/Jun/2010 09:37

Design weather:

Source	ASHRAE design weather database
Weather location	Chicago , Illinois
Weather file	ChicagoMidwayTMY

Climate zone:

ASHRAE 90.1	5A
Koeppen-Geiger	Dfa

Construction:

This report produces output in accordance with the LEED NC 2.2 Submittal Template, April 2005 - option 1: Performance Rating Method

The Virtual Environment software has all the capabilities described in G2 Simulation General Requirements in Appendix G of ASHRAE 90.1 - 2007

The baseline building and proposed building in this project's energy simulation runs use the assumptions and modelling methodology described in Appendix G of ASHRAE 90.1 - 2007

The report outputs that sequence with the following 90.1 sections:

1.1 - General info
1.2 - Space Summary
1.3 - Advisory messages
1.4 - Comparison of proposed design versus baseline design energy model inputs
1.5 - Energy type summary
1.6 - On site renewable energy (if applicable)
1.7 - Exceptional calculation measure summary (if applicable)
1.8 - Performance rating method compliance report

Report images can be replaced by:

1. Open model viewer
2. Adjust the model view accordingly
3. Save the image to the VISTA BPRM folder with the project Vista file, over write appropriate default BMP default file & regenerate report.

4. Table 1.2 – Space Summary

1.2 - Space Summary

Table 1.2 Space Summary

Building Use (Occupancy type)	Conditioned Area ft^2	Un-conditioned Area ft^2	Total Area ft^2
A-Z	Hi/Lo	Hi/Lo	Hi/Lo
SPACE: Office - Open plan	2,153	0	2153
Totals	2,152.8	0.0	2,152.8

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Table 1.3 – Advisory Messages

1.3 - Advisory Messages

Table 1.3 - Advisory messages

Advisory Messages	Proposed Building	Baseline Building	Difference
Number of hours heating loads not met - to be manually assessed by user			
Number of hours cooling loads not met - to be manually assessed by user			
Number of warning messages:	0	0	0
Number of error messages:	0	0	0
Number of defaults overridden	0	0	0

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Table 1.4 – Comparison of Proposed versus Baseline Design

1.4 - Comparison of Proposed versus Baseline Design

Table 1.4 - Proposed vs Baseline Const.

Model Input parameter Construction	Proposed		Baseline	
	Description	Input U value / % (area weighted)	Description	Input U value / % (area weighted)
Exterior wall construction	standard wall construction (2002 regs)	0.35	CZ5 Ext Wall (Non-Res) - Steel Framed; R-13.0 + 7.5 (2.3 + 1.3); U=0.064 (0.365)	0.36
Roof construction	flat roof (2002 regs)	0.25	CZ5 Roof (Non-Res) - Ins Above Deck; R-20 (3.5); U=0.048 (0.273)	0.27
Floor/slab construction	standard floor construction (2002 regs)	0.25	CZ5 Floor (Non-Res) - Steel Joist; R-30.0 (5.3); U=0.038 (0.214)	0.21
Window to gross wall ratio	Overall	80%	Overall	40%
Window area distribution	North / South / East / West	80 / 80 / 80 / 80%	North / South / East / West	40 / 40 / 40 / 40%
Fenestration U-Value (North)	low-e double glazing (6mm+6mm) (2002 regs)	1.98	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	3.00
Fenestration U-Value (non - North)	low-e double glazing (6mm+6mm) (2002 regs)	1.98	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	3.00
Fenestration SHGC - North	low-e double glazing (6mm+6mm) (2002 regs)	0.64	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.42
Fenestration SHGC - non - North	low-e double glazing (6mm+6mm) (2002 regs)	0.64	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.42
Fenestration visual light transmittance (N)	low-e double glazing (6mm+6mm) (2002 regs)	0.76	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.76
Fenestration visual light transmittance	low-e double glazing (6mm+6mm) (2002 regs)	0.76	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.76
Shading devices	None		None	

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Table 1.4 - Proposed vs Baseline MEP

Model Input parameter MEP	Proposed		Baseline	
	Description	Input (area weighted)	Description	Input (area weighted)
Other Lighting Controls	None		None	
Interior lighting power density	Total power density (Btu/h•ft^2)	2.73	Total power density (Btu/h•ft^2)	3.75
Day lighting controls	Radiance simulation	No	Radiance simulation	No
Exterior lighting power	Total power consumption (kBtu/h)	17.57	Total power consumption (kBtu/h)	18.45
Process lighting	Total power density (Btu/h•ft^2)	0.00	Total power density (Btu/h•ft^2)	0.00
Receptacle equipment	Total power density (Btu/h•ft^2)	5.12	Total power density (Btu/h•ft^2)	5.12
Elevators/escalators	Total power density (Btu/h•ft^2)	0.00	Total power density (Btu/h•ft^2)	0.00
Refridgeration equipment	Total power density (Btu/h•ft^2)	0.00	Total power density (Btu/h•ft^2)	0.00
Cooking equipment	Total power density (Btu/h•ft^2)	0.00	Total power density (Btu/h•ft^2)	0.00
Data processing/centre equipment	Total power density (Btu/h•ft^2)	0.00	Total power density (Btu/h•ft^2)	0.00

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Table 1.4 - Proposed vs Baseline HVAC

Model Input parameter HVAC	Proposed		Baseline	
	Description	Performance SCop / SSEER Cfm / SFP / kW	Description	Performance SCop / SSEER Cfm / SFP / kW
Primary HVAC system	VAVwRH		VAVwRH	
Other HVAC system	None		None	
Fan supply power		3900 cfm		3244 cfm
Fan power				
Economiser control	Dy Bulb		Dy Bulb	
Demand control ventilation	None		None	
Unitary equip cooling efficiency	None		None	
Unitary equip heating efficiency	None		None	
Chiller	EWC	5.1	EWC	5.1
Chilled water loop and pump		22 w/gpm		22 w/gpm
Boiler	Fossil Fuel (Gas)		Fossil Fuel (Gas)	0.8
Hot water loop and pump				
Cooling tower	2 Speed	42.54 kW	2 Speed	32.29 kW
Condenser water loop and pump		19w/gpm		19w/gpm

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Table 1.5 – Energy Type Summary

1.5 - Energy Type Summary

Table 1.5 - Energy type summary

Energy Type Proposed / baseline design	Utility rate description	Units of Energy	Units of demand
Electricity	State generic - eGrid	kBtu	MBH
Gas	State generic - eGrid	kBtu	MBH
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

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Table 1.6 – On Site Renewable Energy

1.6 - On Site Renewable Energy

Table 1.6 - On site Renewables

Renewable Source	Back up Energy Type	Annual Energy Generated(kBtu)	Rated Capacity(MBH)	Renewable Energy Cost($)
Photovoltaic Panels	Electricity	0.00	0.00	0.00
Wind Power	Electricity	0.00	682.43	0.00
Combined Heat and Power	Electricity	0.00	1.71	0.00
Solar Water Heating	Electricity	0.00	0.00	0.00

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Table 1.7 - Exceptional Calculation Methods

1.7 - Exceptional Calculation Measures

The Energy Analysis does not include exceptional calculation method (s)	ASHRAE 90.1 - 2007, G2.5

Detailed Simulation Reports

Proposed

This step enables the generation or display of the 10 minute checklist report for the proposed model. The report contains four separate sections.

Building Utility Performance Table:

Building Utility Performance

16/Jun/2010

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Simulated: 16/Jun/2010 at 10:30
Weather file: ChicagoMidwayTMY.fwt

Building Utility Performance

Fuel type	Internal Lighting kWh	Exterior Lighting kWh	Space Heating kWh	Space Cooling kWh	Pumps kWh	Heat Rejection kWh	Fans Interior kWh	Fans Parking Garage kWh	Service Water Heating kWh	Service Water Heating kWh	Receptacle Equipment kWh	Interior Lighting Process kWh	Refrigeration kWh	Data Centre Equipment kWh	Elevators Escalators kWh	Space Heating kWh	Cooking kWh	Cooking kWh	Total kWh	Total kWh/ft² gross	Total kWh/ft² net
All fuels SI units:																					
Electricity	5,032	25,580	0	6,041	377	1,884	5,791	0	0	0	9,436	0	0	0	0	0	0	0	54,141	25.15	25.15
Fossil Fuels	0	0	34,075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,075	15.83	15.83
Renewables	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Totals	5,032	25,580	34,075	6,041	377	1,884	5,791	0	0	0	9,436	0	0	0	0	0	0	0	88,216	40.98	40.98
Fossil Fuels only alternative units (MBtu):																					
Fossil Fuels	0.0	0.0	116.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.3	0.05	0.05
Totals	0.0	0.0	116.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.3	0.05	0.05

TOTAL ELECTRICITY	54,141.2 kWh	25.149 kWh / ft²-yr gross area
TOTAL FOSSIL FUELS	116.3 MBtu	0.054 MBtu / ft²-yr gross area

Notes: Energy is reported hourly to all end use categories
This report lists delivered or site energy (energy summated across the building boundary or metering point)

This table details the utility breakdown for each of the end use categories associated with the PRM analysis and includes electricity, fossil fuels and any renewables.

The report also displays the total energy associated with electricity and fossil fuels.

Building Energy Performance Table:

Building Energy Performance

16/Jun/2010

INTEGRATED ENVIRONMENTAL SOLUTIONS LTD

Simulated: 16/Jun/2010 at 10:30
Weather file: ChicagoMidwayTMY.fwt

Building Energy Performance

Fuel type	Internal Lighting MBtu	Exterior Lighting MBtu	Space Heating MBtu	Space Cooling MBtu	Pumps MBtu	Heat Rejection MBtu	Fans Interior MBtu	Fans Parking Garage MBtu	Service Water Heating MBtu	Service Water Heating MBtu	Receptacle Equipment MBtu	Interior Lighting Process MBtu	Refrigeration MBtu	Data Centre Equipment MBtu	Elevators Escalators MBtu	Space Heating MBtu	Cooking MBtu	Cooking MBtu	Total MBtu	Total kBtu/ft^2 gross	Total kBtu/ft^2 net
Electricity	17.2	87.3	0.0	20.6	1.3	6.4	19.8	0.0	0.0	0.0	32.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	184.7	85.81	85.81
Fossil Fuels	0.0	0.0	116.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.3	54.01	54.01
Totals	17.2	87.3	116.3	20.6	1.3	6.4	19.8	0.0	0.0	0.0	32.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	301.0		
Total Site energy:																				139.82	139.82

TOTAL SITE ENERGY	301.00 MBtu	139.8 kBtu / ft^2-yr gross-area

Notes: Energy is reported hourly to all end use categories
This report lists delivered or site energy (energy summated across the building boundary or metering point)

This table details an energy breakdown for each of the end use categories associated with the PRM analysis.

The report also displays the total site energy calculated.

Building Energy & End Use Summary Table - Electricity:

Building Energy & End-Use Summary

16/Jun/2010

INTEGRATED ENVIRONMENTAL SOLUTIONS LTD

Report for All Electric Meters

Simulated: 16/Jun/2010 at 10:30
Weather file: ChicagoMidwayTMY.fwt

Month	Category	Internal Lighting	Exterior Lighting	Space Cooling	Pumps	Heat Rejection	Fans Interior	Fans Parking Garage	Service Water Heating	Receptacle Equipment	Interior Lighting Process	Refrigeration	Data Centre Equipment	Elevators Escalators	Space Heating	Cooking	Total
January	kWh	410.5	2,647.1	1.6	3.5	1.4	278.1	0.0	0.0	769.8	0.0	0.0	0.0	0.0	0.0	0.0	4,112.0
	Max kW	1.5	5.1	0.1	0.1	0.1	1.4	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	10.2
	Day / Hour	1 / 08:30	1 / 00:30	31 / 08:30	29 / 06:30	31 / 08:30	8 / 13:30	1 / 00:30	1 / 00:30	1 / 08:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	26 / 08:30
	Peak end use	1.5	5.2	0.0	0.0	0.0	0.5	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
	Peak PCT	15.3	50.7	0.0	0.1	0.0	5.3	0.0	0.0	28.6	0.0	0.0	0.0	0.0	0.0	0.0	
February	kWh	385.7	2,177.6	0.9	2.5	0.8	264.0	0.0	0.0	723.3	0.0	0.0	0.0	0.0	0.0	0.0	3,554.8
	Max kW	1.5	5.1	0.1	0.1	0.1	1.7	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	10.1
	Day / Hour	1 / 08:30	1 / 00:30	20 / 07:30	2 / 06:30	20 / 07:30	25 / 14:30	1 / 00:30	1 / 00:30	1 / 08:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	3 / 08:30
	Peak end use	1.5	5.2	0.0	0.0	0.0	0.5	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
	Peak PCT	15.4	51.0	0.0	0.1	0.0	4.7	0.0	0.0	28.8	0.0	0.0	0.0	0.0	0.0	0.0	
March	kWh	439.5	2,145.8	10.3	2.9	9.4	298.0	0.0	0.0	824.0	0.0	0.0	0.0	0.0	0.0	0.0	3,730.0
	Max kW	1.5	5.1	1.0	0.1	0.9	3.2	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	9.5
	Day / Hour	1 / 08:30	1 / 00:30	25 / 12:30	18 / 15:30	25 / 13:30	18 / 15:30	1 / 00:30	1 / 00:30	1 / 08:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	18 / 15:30
	Peak end use	1.5	0.0	0.9	0.1	0.8	3.2	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
	Peak PCT	16.2	0.0	9.4	1.4	8.7	33.8	0.0	0.0	30.4	0.0	0.0	0.0	0.0	0.0	0.0	
April	kWh	421.5	1,900.4	103.4	13.9	80.5	367.8	0.0	0.0	790.5	0.0	0.0	0.0	0.0	0.0	0.0	3,678.0
	Max kW	1.5	5.1	2.6	0.3	1.1	4.1	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	12.6
	Day / Hour	1 / 08:30	1 / 00:30	16 / 16:30	16 / 16:30	17 / 13:30	16 / 16:30	1 / 00:30	1 / 00:30	1 / 08:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	16 / 16:30
	Peak end use	1.5	0.0	2.6	0.3	1.1	4.1	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
	Peak PCT	12.3	0.0	21.1	2.0	8.8	32.7	0.0	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.0	
May	kWh	410.5	1,784.5	514.9	34.7	194.1	524.4	0.0	0.0	769.8	0.0	0.0	0.0	0.0	0.0	0.0	4,232.9
	Max kW	1.5	5.1	4.9	0.4	1.2	4.6	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	15.6
	Day / Hour	3 / 08:30	1 / 00:30	12 / 16:30	12 / 16:30	12 / 15:30	12 / 16:30	1 / 00:30	1 / 00:30	3 / 08:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	1 / 00:30	12 / 16:30
	Peak end use	1.5	0.0	4.9	0.4	1.2	4.6	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
	Peak PCT	9.9	0.0	31.4	2.3	7.9	29.8	0.0	0.0	18.6	0.0	0.0	0.0	0.0	0.0	0.0	

This table shows a detailed breakdown of the monthly performance of each of the PRM end use categories for all electric meters.

The annual electricity energy is also shown for each end use and summed to give the total annual electrical energy.

Note: The total column in this report may not be the sum of end uses; any excess generated electricity (negative total) is assumed to be exported

Building Energy & End Use Summary Table – Fossil Fuel:

Building Energy & End-Use Summary

16/Jun/2010

INTEGRATED ENVIRONMENTAL SOLUTIONS LTD

Report for All Fossil Fuels

Simulated: 16/Jun/2010 at 10:30
Weather file: ChicagoMidwayTMY.fwt

Month	Category	Space Heating	Service Water Heating	Cooking	Total
January	kBtu	27,269.0	0.0	0.0	27,269.0
	Max kBtu/h	104.4	0.0	0.0	104.4
	Day / Hour	27 / 07:30	1 / 00:30	1 / 00:30	27 / 07:30
	Peak end use	104.4	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	
February	kBtu	21,570.0	0.0	0.0	21,570.0
	Max kBtu/h	97.3	0.0	0.0	97.3
	Day / Hour	2 / 06:30	1 / 00:30	1 / 00:30	2 / 06:30
	Peak end use	97.3	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	
March	kBtu	15,288.4	0.0	0.0	15,288.4
	Max kBtu/h	85.7	0.0	0.0	85.7
	Day / Hour	5 / 07:30	1 / 00:30	1 / 00:30	5 / 07:30
	Peak end use	85.7	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	
April	kBtu	5,903.4	0.0	0.0	5,903.4
	Max kBtu/h	58.5	0.0	0.0	58.5
	Day / Hour	2 / 07:30	1 / 00:30	1 / 00:30	2 / 07:30
	Peak end use	58.5	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	
May	kBtu	1,533.0	0.0	0.0	1,533.0
	Max kBtu/h	43.8	0.0	0.0	43.8
	Day / Hour	10 / 07:30	1 / 00:30	1 / 00:30	10 / 07:30
	Peak end use	43.8	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	
June	kBtu	187.7	0.0	0.0	187.7
	Max kBtu/h	26.6	0.0	0.0	26.6
	Day / Hour	28 / 07:30	1 / 00:30	1 / 00:30	28 / 07:30
	Peak end use	26.6	0.0	0.0	
	Peak PCT	100.0	0.0	0.0	

This table shows a detailed breakdown of the monthly performance of each of the PRM end use categories for all fossil fuel meters. The annual fossil fuel energy consumption is also shown for each end use and summed to give the total annual fossil fuel energy consumption.

Baseline 0°

This enables generation or display of the Detailed Simulation Report for the baseline 0° model.

Baseline 90°

This enables generation or display of the Detailed Simulation Report for the baseline 90° model.

Baseline 180°

This enables generation or display of the Detailed Simulation Report for the baseline 180° model.

Baseline 270°

This enables generation or display of the Detailed Simulation Report for the baseline 270° model.

ASHRAE 62.1

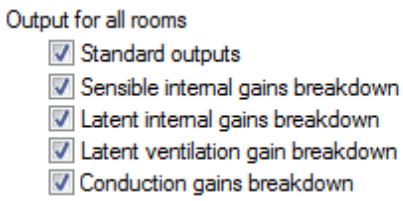
Display Selected Reports

This action provides for the selection and display BPRM Reports for individual PRM runs (proposed plus four baselines), if multiple simulation runs have been performed. For example, you may have run a number of scenarios to be compared or may have completed a separate run as an Exceptional Calculation Method or with renewable energy systems added, etc. that will be separately reported in the submittal.

Additional Documentation of VE Results for LEED EA credit 1 submittal

The majority of the data needed for the LEED submittal is included in the BPRM Reports, Detailed Simulation Reports, and ASHRAE 62.1 ventilation report described above. It may be desirable to include additional documentation, such as the System Sizing reports as introduced in the Sizing Runs section of this user guide.

- When you complete the **Room** Loads Calculation step in either the System Prototypes & Sizing or PRM Navigator, this generates a loads report. It is best to use the report generated at the time of the loads run used for sizing of zone airflows, etc. If the Conduction Gains Breakdown and other internal gains breakdowns are checked in the Output Options dialog within ASHRAE Loads, then that data will be recorded for query in Vista Results and for display in the loads report.
    - When running ASHRAE Loads, the recommended Simulation Options for achieving a high level of accuracy in results are as follows:
        - External convection model: **McAdams** (this model varies the convection coefficients with wind speed and surface-to-air delta-T)
        - Internal convection model: **Alamdari & Hammond** (this model varies the convection coefficients with surface-to-air delta-T)
    - The suggested Output Options for detailed documentation are as follows:



    - To have the loads report include detailed results for each zone or separate space in the model (including UFAD plenums, occupied zones, stratified zones, etc.), once in Vista Results and prior to clicking the report generator button on the toolbar, you will need to go to Report Preferences on the Settings menu and select Detailed room loads. This will add a report section for each space.
- When you complete the **System** Load Calculations step in either the System Prototypes & Sizing or PRM Navigator, this will then generate a similar report for each space, this time including much more information about the actual loads and flow rates, etc. for each zone as seen by the actual system at the time of sizing. The following is an example of one system section and one zone section of from this report. Note that presently, this system

sizing report can be generated and displayed *only* via one of the two workflow navigators named above. As of VE 6.4, this will also be generated by a sizing run initiated from within ApacheHVAC and accessed directly from the Vista Results viewer.

SYSTEM SIZING plant loads

Heating Plant

Equipment Name	Equipment Type	Area served (ft^2)	Peak Load (kBtu/h)	Time of Peak
BR000011	2 Nat-Draft Boilers, Primary Loop, Const-speed pump	10776.0	205.0	Sized during heating
BR000034	Furnace for PSZ units - AFUE rather than stedy-state eff.	3592.0	151.2	Sized during heating

Cooling Plant

Equipment Name	Equipment Type	Area served (ft^2)	Peak Load (kBtu/h)	Time of Peak
CR000001	EWC Chiller with default values and VSD sec'd pump, 2-sp clg tower fan	7184.0	70.0	7/1516:30

SYSTEM SIZING system loads

System Loads

System ID	System Name	Area Served (ft^2)
PR07_034		3592.0

Coil Sizes	AHU Cooling Coil Sensible Load (kBtu/h)	AHU Cooling Coil Latent Load (kBtu/h)	AHU Cooling Coil Total Load (kBtu/h)	AHU Heating Coil Total Load (kBtu/h)
Peak value	70.0	-0.0	70.0	51.6
Time of Peak	7/1516:30	7/1516:30	7/1516:30	Sized during heating

Fan Sizes	AHU Supply Fan Flow (cfm)	AHU Return Fan Flow (cfm)	Optional Exhaust Fan Flow (cfm)	Min Vent Airflow (cfm)
Peak Value	1874.1	948.1	200.0	144.2
Time of Peak	7/1515:30	7/1515:30	Sized during heating	

Engineering Checks	Cooling Checks			Heating Checks		
	cfm/ft^2	$Btu/h{\cdot}ft^2$	% OA	cfm/ft^2	$Btu/h{\cdot}ft^2$	% OA
Peak Value	0.5	19.5	7.7	0.3	42.71	11.5
Time of Peak	7/1516:30	Calculated at time of Peak Cooling Coil Load		Sized during heating	Calculated at time of Peak Heating Coil Load	

Rooms Served by System	Components					Airflows			
	Cooling Coil Sensible Load (kBtu/h)	Cooling Coil Latent Load (kBtu/h)	Cooling Coil Total Load (kBtu/h)	Heating Coil Total Load (kBtu/h)	Zone recirc Fan Flow (cfm)	Maximum Flow (cfm)	Minimum Flow (cfm)	Exhaust Flow (cfm)	OA Flow (cfm)
01 - Interior	-	-	-	8.70	-	417.4	333.9	0.0	151.7
01 East	-	-	-	11.70	-	530.3	159.1	0.0	87.4
01 North	-	-	-	7.30	-	271.6	108.7	0.0	65.5
01 South	-	-	-	12.00	-	573.1	229.2	0.0	109.2
01 West	-	-	-	11.20	-	484.4	145.3	0.0	87.4
01 _ Services	-	-	-	0.00	-	200.0	200.0	200.0	0.0

SYSTEM SIZING loads - room data summaries

01 East

01 East						
Room input data		Peak room cooling loads (Btu/h)			Peak room heating loads (Btu/h)	
Geometry		Exterior Conduction Gains	Sensible	Latent	Exterior Conduction Gains	Sensible
Floor area (ft^2)	576.0	Ext. Walls	105	0	Ext. Walls	-2,208
Volume (ft^3)	5184.0	Ext. Glazing	-311	0	Ext. Glazing	-5,923
Ext. wall area (ft^2)	447.8	Skylights Conduction	0	0	Skylights Conduction	0
Int. wall area (ft^2)	87.0	Roof	0	0	Roof	0
Ext. window area (ft^2)	236.2	Ground/Exposed Floor	-2,972	0	Ground/Exposed Floor	963
Int. window area (ft^2)	0.0	Door	0	0	Door	0
Skylight area (ft^2)	0.0	Internal Conduction Gains	Sensible	Latent	Internal Conduction Gains	Sensible
Room Data		Int. Walls	-31	0	Int. Walls	-19
Lighting load (W/ft^2)	0.8	Int. Glazing	0	0	Int. Glazing	0
Power load (W/ft^2)	1.0	Ceiling	-793	0	Ceiling	82
Number of people	3.8	Floor	0	0	Floor	0
Area / person (ft^2)	151.6	Door	-15	0	Door	-6
Sens gain / pers	252.58					
Latent gain / person	202.13	Solar Gains	11,079	0	Solar Gains	0
Heating set point (°F)	68.0					
Cooling set point (°F)	75.0	Infiltration Gains	-3	-22	Infiltration Gains	-906
Max rel. humidity %	60.0					
Min rel. humidity %	0.0	Other air exchange gains	0	0	Other air exchange gains	0
62.1 Occupancy Category	Office Buildings - Office Space	Internal Gains	Sensible	Latent	Internal Gains	Sensible
		Lighting	1,572	0	Lighting Gains	0
		Equipment	1,965	0	Equipment	0
		People	960	768	People	0
		Totals	11,558	746	Totals	-8,017

Design Air Flows		Environmental conditions - Peak Rm Cooling		Environmental conditions - Rm Heating	
Cooling Air Flow(cfm)	530.3	Date	Jul		
Min Air Flow(cfm)	159.1	Time	09:30		
Heating Air Flow(cfm)	375.2	Ext. Drybulb Temp	76.29	Ext. Drybulb Temp	3.20
Return Air Flow(cfm)	530.3	Ext. Wetbulb Temp	53.86	Ext. Wetbulb Temp	1.04
Exhaust Air Flow(cfm)	0.0	Ext. RH	23	Ext. RH	50
Ventilation Air Flow (62.1 Voz)(cfm)	87.4	Room Drybulb Temp	74.74	Room Drybulb Temp	67.11
		Room RH	26	Room RH	4
		Engineering Checks (Cooling)		Engineering Checks (Heating)	
		Air changes per hour	6.1	Air changes per hour	4.3
		cfm/ft^2	0.9	cfm/ft^2	0.7
		$Btu/h{\cdot}ft^2$	22.2	$Btu/h{\cdot}ft^2$	19.2
		% OA	16.5	% OA	23.3

Heating Coil ID: HC002798	
Sensible(kBtu/h)	11.7
Air Flow at Peak(cfm)	255.4
Heating Coil ID: HC002798	
Sensible(kBtu/h)	11.7
Air Flow at Peak(cfm)	255.4

Environmental conditions - Peak Heating Coil	
Heating Coil ID: HC002798	
Date	Sized during heating
Time	
Ext. Drybulb Temp(°F)	3.2
Ext. Wetbulb Temp(°F)	1.0
Ext. RH	50.0
Entering (db) Temp(°F)	53.0
Leaving (db) Temp(°F)	95.0
Heating Coil ID: HC002798	
Date	Sized during heating
Time	
Ext. Drybulb Temp(°F)	3.2
Ext. Wetbulb Temp(°F)	1.0
Ext. RH	50.0
Entering (db) Temp(°F)	53.0
Leaving (db) Temp(°F)	95.0

Note that for non-standard systems and equipment, certain plant items may not show up in the System Sizing reports above, as they are not dealt with in the same manner as other more standard equipment. For example, if an Indirect-Direct Evaporative Cooling system is used in the proposed design, the cooling section of this actually consists of a couple spray chambers, a heat exchanger, a bypass damper or two, and controllers for the target leaving conditions. As there are many ways to set this up, size the components, and control the cooling effect, this does not lend itself to autosizing per se, nor are there appropriate values to report as would otherwise be the case for a cooling coil or chiller. For example, in the case of capability for a spray chamber to achieve the maximum saturation performance of the selected unit (*e.g.,* 84% effectiveness), the normal configuration would allow the spray chamber to add as much water to the airstream as required to achieve this level of performance. It is then up to the engineer to ensure that the actual selected unit can achieve this at the design cooling conditions, including entering air conditions and flow rates.

1.4 - Comparison of Proposed versus Baseline Design

Table 1.4 - Proposed vs Baseline Const.

Model Input parameter Construction	Proposed		Baseline	
	Description	Input U value / % (area weighted)	Description	Input U value / % (area weighted)
Exterior wall construction	DESIGN Below Grade Wall R-10	0.20	ASHRAE ExternalWall: Below Ground C=0.119	0.50
Exterior wall construction	DESIGN Ext Wall R-21.45	0.26	CZ5 Ext Wall (Non-Res) - Steel Framed; R-13.0 + 7.5 (2.3 + 1.3); U=0.064 (0.365)	0.36
Roof construction	DESIGN Roof R-30	0.18	CZ5 Roof (Non-Res) - Ins Above Deck; R-20 (3.5); U=0.048 (0.273)	0.27
Roof construction	DESIGN Roof R-38	0.15		
Floor/slab construction	DESIGN Floor F-0.052	0.06	Ground contact floor: U=F(0.73)*Floor perim. (891.509ft)/Floor area (19478.3ft^2)	0.11
Floor/slab construction			CZ5 Floor (Non-Res) - Steel Joist; R-30.0 (5.3); U=0.038 (0.214)	0.21
Window to gross wall ratio	Overall	24%	Overall	24%
Window area distribution	North / South / East / West	26 / 20 / 16 / 33%	North / South / East / West	26 / 20 / 16 / 33%
Fenestration U-Value (North)	Type 1 - Single clear float glazing	3.96	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	3.00
Fenestration U-Value (North)	Solarban 60 SHGC-0.38 U-0.27	1.50		
Fenestration U-Value (non - North)	Type 1 - Single clear float glazing	3.96	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	3.00
Fenestration U-Value (non - North)	Solarban 60 SHGC-0.38 U-0.27	1.50		
Fenestration SHGC - North	Type 1 - Single clear float glazing	0.85	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.42
Fenestration SHGC - North	Solarban 60 SHGC-0.38 U-0.27	0.30		
Fenestration SHGC - non - North	Type 1 - Single clear float glazing	0.85	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.42
Fenestration SHGC - non - North	Solarban 60 SHGC-0.38 U-0.27	0.30		
Fenestration visual light transmittance (N)	Type 1 - Single clear float glazing	0.00	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.76
Fenestration visual light transmittance (N)	Solarban 60 SHGC-0.38 U-0.27	0.61		
Fenestration visual light transmittance	Type 1 - Single clear float glazing	0.00	CZ5 Window (Non-Res) - Metal framing (all other) U=0.55(3.12); SHGC=0.40	0.76
Fenestration visual light transmittance	Solarban 60 SHGC-0.38 U-0.27	0.61		
Shading devices				

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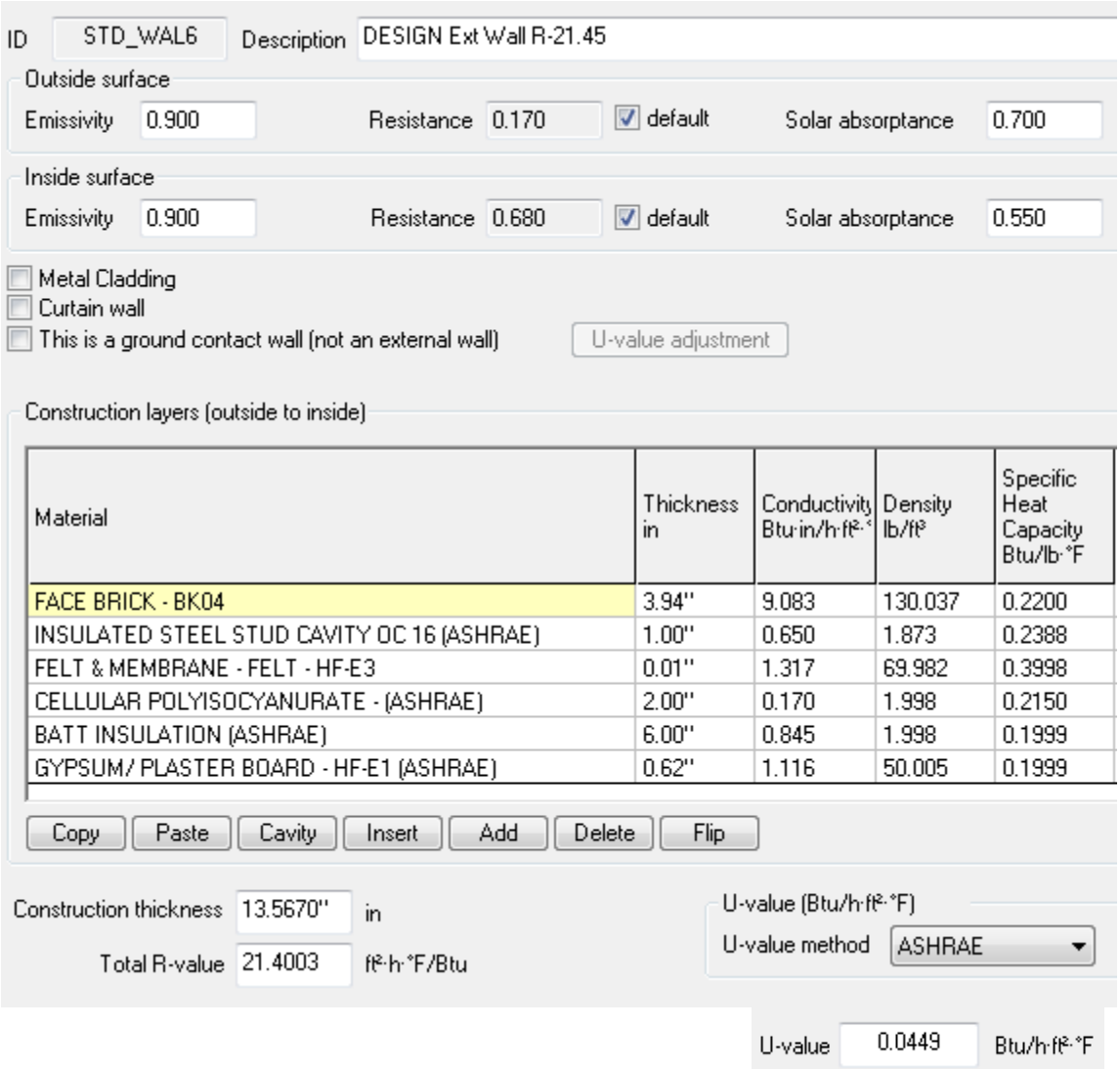
Section 1.4 Proposed vs. Baseline Constructions in the BPRM Reports will provide most of the necessary documentation (as shown above) for these aspects of the modeling. However, some users may wish to provide additional supporting detail regarding constructions.

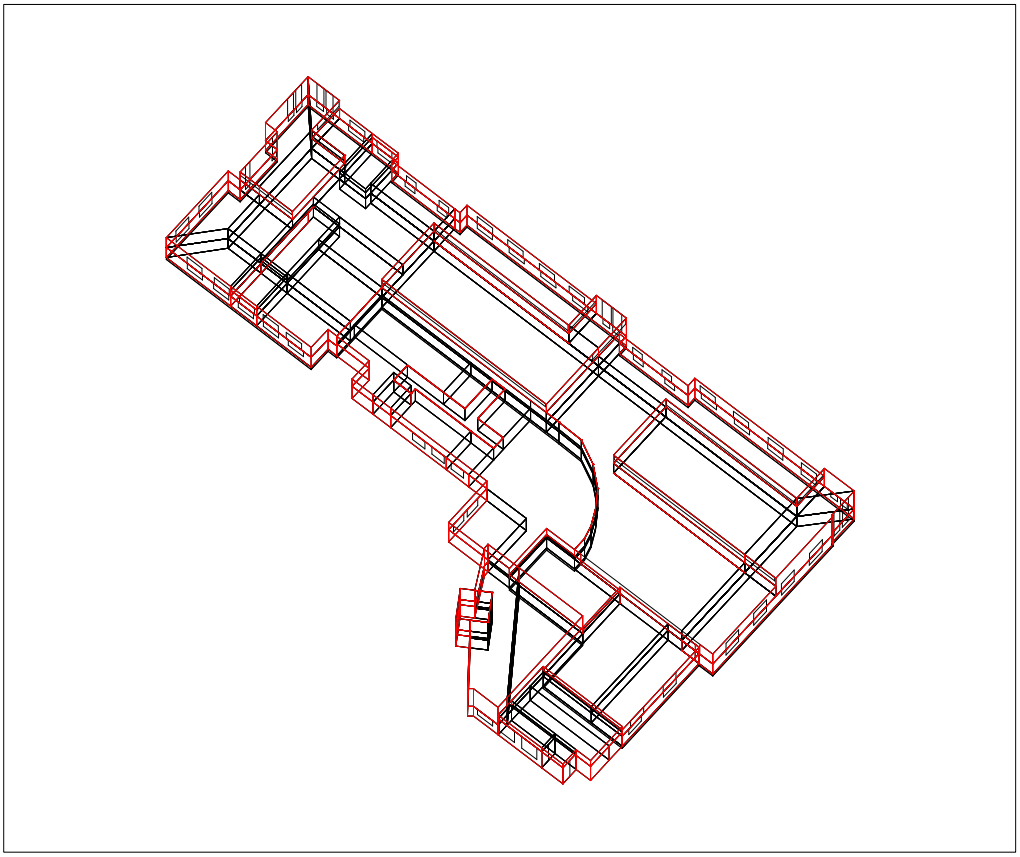
For example, it might be desirable to make a list of the constructions used in the model, then paste in screen captures, such as that shown below, for each of these constructions (*e.g.,* if you want to include the ASHRAE U-value calculations (which use ASHRAE rather than CIBSE or ISO values for indoor and outdoor temperatures and air-film resistance).



It may then be helpful to copy the image of the building with red highlights from the Construction Assignment dialog (use the Copy button) and paste this in to show where in the model each construction type has been applied. An example of this is included below. The copy of this image also comes with a text version of the contents of the dialog above; however, this includes only the CIBSE and ISO U-values. While these can be forced to match the ASHRAE values by fixing the inside and outside air-film resistances at the ASHRAE values in the construction, doing so will negate the effect of variable convective heat transfer coefficients if they are selected for the simulation (in the ApacheSim dialog).

DESIGN Ext Wall R-21.45
Reference ID: STD_WAL6
Construction is a from the project database

Layer Description	Thickness ft	Conductivity Btu·in/h·ft²·°F	Density lb/ft³	Capacity Btu/lb·°F	Resistance ft²·h·°F/Btu
FACE BRICK - BK04	0.3281	9.083	130.0	0.2	0.0361
INSULATED STEEL STUD CAVITY OC 16 (ASHRAE)	0.0833	0.650	1.9	0.2	0.1282
FELT & MEMBRANE - FELT - HF-E3	0.0008	1.317	70.0	0.4	0.0006
CELLULAR POLYISOCYANURATE - (ASHRAE)	0.1667	0.170	2.0	0.2	0.9804
BATT INSULATION (ASHRAE)	0.5000	0.845	2.0	0.2	0.5917
GYPSUM/ PLASTER BOARD - HF-E1 (ASHRAE)	0.0517	1.116	50.0	0.2	0.0463
Inside Surface					0.680
Outside Surface					0.170
Total Resistance					2.633
CIBSE Net U-Value Btu/h·ft²·°F	0.0449				
EN-ISO U-Value Btu/h·ft²·°F	0.0447				
Outside surface absorptance	0.7000				
Inside surface absorptance	0.5500				
Inside Emissivity	0.9000				
Outside Emissivity	0.9000				



- **Results**
  - BPRM Report
    - User details
    - Data for Tables 1.3 and 1.4
    - Cost Savings Summary - Table 1.8.2(b)
    - Energy Savings Summary - Table 1.8.2
    - Baseline Costs - Table 1.8.1 (b)
    - Baseline Energy - Table 1.8.1
    - Full Report
  - Detailed Simulation Reports
    - Proposed
    - Baseline 0
    - Baseline 90
    - Baseline 180
    - Baseline 270
  - ASHRAE 62.1
    - Proposed
    - Baseline 0
    - Baseline 90
    - Baseline 180
    - Baseline 270
  - Display Selected Reports

Appendix A: Using the PRM Navigator with a substantially completed model

Using the PRM Navigator when starting with a completed model and HVAC system file for the proposed design, rather than starting within the navigator

Thermal modeling considerations

The following assumes that the model already had complete geometry, proper U-effective values in ground-contact constructions, infiltration rates, solar shading calcs, daylight sensor data and formula profiles assigned if daylighting controls are included, detailed internal gains and schedules defined, thermal templates assigned, possible modifications to Room Data, etc., and therefore it would not be appropriate to remove all custom thermal templates and re-assign the 90.1 space-by-space thermal templates.

Skip over steps not listed below, unless these have not been completed with respect to the proposed design model as an independent project.

Preliminary data set up:

1. Use the Prototype Data (ASHRAE Baseline) link in the navigator to acquire required grouping schemes, thermal templates, and other needed data.
2. Manually complete the Room/Zone Group Assignment step, sorting the spaces in the model into the appropriate groups with the 90.1 space-by-space methods Grouping Scheme.

Envelope Thermo-physical Properties:

3. Use the ASHRAE Baseline Constructions link in the navigator to acquire required constructions associated with the ASHRAE Climate Zone that is automatically determined by the set location and weather file for the project.

Room/Zone Thermal Template Data:

4. Room conditions (Setpoints, plus schedules and receptacle loads):
    - Consistent with the sorting of spaces in the model into the appropriate groups with the 90.1 space-by-space methods Grouping Scheme, revise the heating and cooling Setpoints in a select subset of the Space-by-space thermal templates to match those of the thermal templates previously set up for the proposed design. Note that in both the proposed and the baseline thermal templates, the setpoints entered here should be the *design* heating and cooling set points that will be used for system sizing and which the heating and cooling proportional control bands will straddle.
    - Consistent with the same sorting of spaces in the model, revise the schedules (profiles other than daylight dimming) for all internal gains in the baseline profiles to match those of the corresponding templates used in the proposed design.
    - Consistent with the same sorting of spaces in the model, revise the Receptacle Equipment (computers, etc.) loads to be the same in the baseline as proposed, except when a difference between these is to be documented as an energy efficiency measure.
    - These templates will need to be manually assigned to the Baseline model after it is generated (see below).

5. Exterior Lighting: Complete this step. The exterior lighting will be assigned to the last space on the Rooms list. While these lights will consume energy, there will be no gains to the space to which they are assigned.
6. Elevators: Use this step to add elevator energy consumption if appropriate and not yet included. Again, this will be assigned to the last space in the Rooms list. If elevators have already been included, this tool and the associated schedules that come with the PRM Prototype Data may be of use for improving the representation of elevator use.
7. Service Hot Water (DHW): The consumption rate(s) will have to be defined in one or more of the baseline thermal templates to match that of the proposed design model. Note that as of VE 6.1.1, users can select an independent profile for the consumption pattern (rather tan typing this to occupancy) and can thus put all DHW consumption in one profile for one space or space type, such as a restroom. When the independent profile is selected, the input changes from gallons per hour per person to simply gallons per hour. Whichever method is used, the baseline and proposed will need to be consistent. Also, note that is the proposed design model links the DHW loads to a boiler in ApacheHVAC, the same should be done for the baseline model.

ApacheHVAC System set up, loads, and sizing

The following assumes the starting point stated above and that ApacheHVAC system file was previously completed using the System Prototypes & Sizing navigator or similar VE features, and that this included the implementation of ASHRE 62.1 ventilation rates, if appropriate, via the spreadsheet. Given this, it is assumed that all system sizing has been completed and there are associated Loads Data spreadsheets that have already been generated for each system in the "proposed.asp" file.

8. Make backup copies of both the proposed HVAC system file and the associated Loads Data spreadsheets.
9. Use Edit Current Baseline to open the baseline prototype systems file, choose and copy as needed the appropriate baseline system types, delete unneeded systems.
10. While the Baseline.asp system is open, complete the assignment of spaces in the model to layers in the multiplex using the Assign from Room Group, as was very likely done previously for the proposed design.
11. AHU Parameters: This step will create Loads Data spreadsheets for each of the baseline systems in the Baseline.asp file and provides the opportunity to set any variance from default values for basic parameters. For example, if the ASHRAE requirement for the baseline system outside air economizer high-limit is 75, set this up to 75 from 70 for all systems to which it applies. Revise the AHU cooling coil LAT values so as to be 20 F below the space design cooling setpoint.
12. Again, it is assumed here that the proposed system has previously been set up, scheduled, sized, and tested. If this was completed using the System Prototypes & Sizing navigator or equivalent tools in the VE, the System Schedules dialog should already have been used to set values in the pre-defined system profiles accordingly.

13. Other Input Data: Complete set up of Renewable Energy Systems and Utility Tariffs as appropriate.

14. Generate the baseline model.
15. Check for proper set up of ground-contact constructions with a U-effective adjustment layer, reduction of overall glazing area (if the proposed design has more than 40% of the overall window-to-wall ratio for the entire building—*not* per facade—the glazing should have been reduced to 40%), and so forth.
16. For users with UFAD and DV systems or other thermally stratified environments in the proposed design, this is the time to remove the partitions with holes that separate occupied and stratified zones (or the potentially multiple sub-zones in an atrium that is meant to stratify).
17. If the proposed design model has a double-skin façade, this should also be removed at this time, as follows:
    - Enter ModelIt and switch to Baseline model.
    - Delete the double-skin façade geometry from the baseline model.
    - Return to the BPRM view.
    - At this point the newly exposed facade will have default VE constructions assigned. You must manually assign the baseline exterior wall constructions for this facade.
    - Once the facade constructions have been assigned, the 0 deg baseline model geometry and construction assignment should now be correct.
    - IF *after* removing the double-skin façade the overall window-to-wall ratio for the entire baseline building exceeds 40%, the newly exposed glazing on facades where the DSF was removed will need to be downsized until the overall 40% requirement is met. (If the proposed building had greater than 40% WWR prior to generating the Baseline building, the glazing area on all *exterior* facades will have been automatically reduced to meet the requirement.)
    - For user that have previously generated the other baseline orientations by running Room Load Calculations after generating the baseline model, these other orientations must be refreshed. This is will be dealt with by running the Room Load calculations in a later step. As these other baseline orientations are based on the 0-degree baseline, there will be no need to repeat the steps above.
18. While in the BPRM view, select Baseline (*vs*. Proposed) from the drop-down menu on the toolbar. Then *manually* assign the 90.1 Space-by-space thermal templates to the baseline zones consistent with the sorting of spaces in the model into the appropriate groups with the 90.1 space-by-space methods Grouping Scheme. The grouping will allow efficient selection of multiple zones to which the same template is to be assigned.
19. Go to the Loads Data folder in the Project folder and open the spreadsheets in both the Proposed folder and the Baseline0 folder in matched pairs (one from each folder) for comparison.

20. Duplicate any changes in the changes previously made in the proposed sys spreadsheets, such as ACH rates and 100% transfer air designations for exhausted restrooms on the Room Design Airflows tab, and the space types on the 62.1 ventilation tab (if used) to the baseline version of each spreadsheet. Note that some things here will be specific to the proposed system, such as ventilation effectiveness or any departure from typical supply air temperatures, and should not be duplicated in the corresponding baseline system spreadsheets.
21. Close any spreadsheets for proposed systems that are still open.
22. Open all baseline system spreadsheets residing in the Baseline0 folder (the ones that would have been edited in the previous step above).
23. Calculate the baseline fan-power adjustment value for “A” according to ASHRAE 90.1 section 6.5.3.1.1—taking credit for ducted returns, MERV-13 filtration, energy recovery devices, direct evaporative cooling, etc.—as in the example below. Enter this value for “A” into the green cell under Baseline Fan Curve User Inputs on the appropriate Sys tab (for the baseline system number) in all spreadsheets in the Baseline0 folder, as appropriate. For example, the entry cell is U24 on the Sys 5,7 tab is this pertains to Baseline System type 5 or 7.

    A = sum of (PD × CFM_D/4131)

    where

    PD = each applicable pressure drop adjustment in i.w.c. from Table 6.5.3.1.1B

    CFM_D = the *design* airflow (*i.e*., from the actual design) in CFM through each applicable device (from Table 6.5.3.1.1B)

    Example: If AHU-1 has a MERV 13 filter and a Heat recovery device with design static pressure of 1.2 i.w.c, both at a design flow rate of 20,000 cfm, then...

    A = (0.9*20,000/4134) + (1.2*20,000/4134) = 10.2

    Note that because the adjustments are relative to the design condition in the proposed system, these calculations can be performed prior to sizing the baseline systems. However, the spreadsheet still needs the results of the baseline system sizing to complete its calculation of the final fan efficiency values.

    Entering a number in the spreadsheet for “A” will revise the fan efficiency for each of the five data points for Fan component (*e.g.,* SA fan component S2 on the Sys 5,7 tab, as highlighted in the S2 table from that tab below). The static pressure values for the baseline supply fans will remain unchanged (*e.g.,* at 2.0 i.w.c.). Because TSP is held constant in this calculation, and because the baseline SA fan power is accounting for ALL fans, other than parallel fan-powered boxes, in the baseline system, the resulting efficiency values will appear remarkably low, as in this example:

Appendix A: Using the PRM Navigator with a substantially completed model

System Level ApHVAC Fan Curve Inputs

Fan Curve Details for S2

1 Flow (cfm)	1 Pressure (in. water)	1 Efficiency (%)	2 Flow (cfm)	2 Pressure (in. water)	2 Efficiency (%)	3 Flow (cfm)	3 Pressure (in. water)	3 Efficiency (%)	4 Flow (cfm)	4 Pressure (in. water)	4 Efficiency (%)	5 Flow (cfm)	5 Pressure (in. water)	5 Efficiency (%)
3610.427	2	47.18%	7220.854	2	31.46%	10831.281	2	24.17%	14441.708	2	19.43%	18052.135	2	16.51%

24. Close ALL spreadsheets.
25. Copy ALL revised spreadsheets in the Baseline0 folder to the other three Baseline Loads Data folders (Baseline90, Baseline180, Baseline 270).
26. Execute the Room Loads Calculation step. This will populate the spreadsheets.
27. Assign Room Sizing Data: Ensure that you did indeed make a backup copy of “proposed.asp” prior to executing the Assign Room Sizing Data step, which will populate the controllers in the systems with values form the spreadsheets (you will need this to occur for all baseline system, but presumably do not need it and very likely do not want it for the proposed system).
28. System Load Calculation: The dialog should have “proposed.asp” set as the linked HVAC file. This will then run five times automatically—one for the proposed and four more for the four Baseline systems.
29. For VE 6.1 through 6.2 and all intermediate versions, RATHER than proceeding to the next step, side-step a bug in this by manually transferring the final Fan efficiency values, as follows:
    - The bug, which has been fixed for VE 6.2.1, writes the system re-heat coil sizes to the spreadsheet in the incorrect rows. Thus users of version prior to 6.2.1 should *avoid* using the “Update fan and coil sizing data” step in the navigator. Instead...
    - *Manually* copy the revised efficiency values (after system sizing) from the Fan Curve Details for S2 table, as highlighted in the example above, to the *corresponding* S2 fan components in *each* of the four baseline systems (0, 90, 180, and 270). Note that this cannot properly be done prior to system sizing, as the calculation of these values depends upon the flow rates determined in the sizing (which determine the motor efficiency at design flow as selected automatically by the spreadsheet from a table of ASHRAE values for this parameter).
30. In VE 6.2.1 or newer versions, Update fan and coil sizing data will copy the revised fan efficiency values from the spreadsheets to the baseline systems. Again, these are calculated using a combination of values form the System Loads sizing run, the value for “A” that you calculated and entered, and values for motor efficiency at the design (autosized) flow rate from a lookup table that related motor size and efficiency, per ASHRAE 90.1.

Appendix A: Using the PRM Navigator with a substantially completed model

31. Having completed the step above, you should now have ready-to-use baseline systems. You may want to review the System Sizing Reports at this time.
32. As the fan data in the proposed.asp system file will have been altered by the above (which you probably didn't require if this was already set up properly), you will need to open the most recent HVAC system backup file and Save As "proposed.asp" before proceeding further. This simply resets proposed.asp back to the fully custom-built version.